Compendium of Ahmadu Bello University

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Ahmadu Bello University

2014 Inaugural Lectures







Ahmadu Bello University

Compendium of Ahmadu Bello University 2014 Inaugural Lectures

Compiled and Edited by
Professor B. B. Muhammad Dewu

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Foreword

An inaugural lecture, being a global university tradition, is a significant occasion for showcasing and celebrating the intellectual milestones Professors covered in their journey to scholarship. It also provides a platform for newly-appointed Professors to herald their arrival by informing colleagues, the university community and the general public about their achievements in research, innovation, engagement and teaching activities. Besides providing a ceremonial forum, inaugural lectures also offers certain benefits for those that avail themselves of the various opportunities given by the memorable tradition. Firstly, a new Professor can use the moment to celebrate an important personal accomplishment with family, friends and colleagues, old and new. Secondly, inaugural lectures serve as a testimonial the University offers in recognition and appreciation of the meritorious achievements of the academic staff. Thirdly, through inaugural lectures, the university community can learn about researches that are going on in and around the Faculties, Institutes and Centres. Fourthly, the quality and quantity of inaugural lectures represent an essential component of university social responsibility and corporate mandate to create wider awareness of the latest developments in natural and applied sciences, engineering and technology, arts and humanities, medical sciences, law and social sciences. These are the primary bases that informed the Management decision to re-activate and re-invigorate the inaugural lecture series as part of its agenda to restore the past glory of, and reposition the Ahmadu Bello University to face the challenges of 21st century.

The first of such lectures, titled *'Developing the Livestock of Nigeria'* was delivered by Prof. Glenn H. Beck in 1970. Since then, a number of such lectures have been delivered usually on monthly basis. With increase in the number of new Professors in the University, the monthly event is becoming too challenging for the organizers to accommodate the new Professors for the inaugural lecture. The Management is indeed working out strategies to ensure that new Professors are given the opportunity to showcase their academic achievements.

This publication entitled 'Compendium of ABU 2014 Inaugural Lectures' is informed by the need to compile the series of lectures to provide easy reference for members of the academic community, policy makers and the general public that are interested in the rich intellectual work documented in this compendium. It is hoped that the lectures for the coming years would also be produced in the same manner, while compilation of the past lectures in similar publication is being considered. There is no doubt that preparation and the delivery of inaugural lectures require substantial amount of funds. However, the venture is worth undertaking in view of the enormity of the derivable benefits to the University, the academic community, the general public and the nation at large.

Management would therefore continue to make effort to find other sources of funds to augment Government subvention to continue to support this all-important intellectual activity. Given the vast and willing donor alumni, well-wishers and friends, I believe that successive administrations would find it auspicious to make specific requests to potential donors to consider the funding of Ahmadu Bello University inaugural lectures.

Professor Abdullahi Mustapha
Vice-Chancellor,
March, 2015

Acknowledgement

This important publication, COMPENDIUM OF AHAMDU BELLO UNIVERSITY 2014 INAUGURAL LECTURES, was put together to further document a very important university academic activity that the inaugural lecture represents. It is borne out of the University's Management desire to project this aspect of the University's academic activity to the university community and the general public. In the course of this onerous task, quite many individuals both collectively and as individuals have contributed in no small measure in the success of the project. In this list, the Vice-Chancellor's name, Prof. Abdullahi Mustapha, stands out very clearly, not only for the encouragement in the production of the publication, but his diligence, persistence and overall contribution and support in ensuring that inaugural lectures are duly delivered as at when due, even in the face of the financial challenges the University has been faced with. In the same regard, the members of the University Management have played significant roles in getting the publication produced and all their efforts and cooperation is highly appreciated.

It is worthy of note that without the lectures, there would not have been this volume. The Committee would like to extend its appreciation to all the Professors that have delivered inaugural lectures in this Great University, especially those whose lectures are contained in this volume. In the same regard, we appreciate the support and cooperation ofthe lectures reviewers which is an integral part of the preparation for inaugural lectures delivered in the University. We also appreciate the contributions of the Deans of the Faculties in the preparations for the delivery of inaugural lectures which has greatly assisted in the production of this publication. We say a big thank you and appreciate all the contributions by the Deans, especially the Dean of the Faculty of Medicine, Prof A.G. Bakari.

The publications could not have seen the light of the day without the hard work, diligence and commitment of the members of the University Organised Lecture Committee. They worked tirelessly in the production of this publication and their efforts are highly commendable and greatly appreciated. The members include

Professors (Mrs) O. Alabi, A.K. Kassim, B.B. Muhammad Dewu, Drs G.Y. Sadiq, A. Mojishola, and Mr. BitrusGalmaka, the Committee's Secretary. In the same regard, there are quite a number of groups and persons that have contributed in no small measure in the successful delivery of the inaugural lectures. These include the University band of the University Security Division, the staff of the Public Affairs Directorate, especially those that manage the public address system, staff and students who assist in serving refreshment during the lectures. The Committee is greatly indebted to these group of individuals for the success of this great work. We also appreciate the support and cooperation of the University Press for their assistance in designing the cover page and incorporating all our corrections and producing an excellent publication that this is.

Introduction

The publication titled: *Compendium of Ahmadu Bello University 2014 Inaugural Lectures* is a compilation of inaugural lectures delivered in the year 2014. It arose from the desire of the University Administration to enhance this important University academic activity and deepen academic excellence in the scheme of the University. Each lecture was published when it was presented to the general public. This compilation which is the first of its kind, is meant to produce in a single volume, all the lectures presented in a year for reference and documentation purposes and also serve as a guide to enrich future presentations.

Inaugural lectures, public lectures, Faculty and Departmental seminars are avenues for intellectual discourse where research activities in the University are disseminated. Inaugural lectures provide an interface between the expert in the field, the University and the general public where the subject is presented in a simplified manner and language that can be understood by the audience. This further broadens the understanding and appreciation of the subject concerned thereby bringing out the significance of the work done in the field, the current approaches in the field, the future trends and developments in the field. This important academic activity has been taking place in this great institution as a result of which rich academic materials have emanated that add value and quality to the academic culture of Ahmadu Bello University, Zaria. A good example can be seen in the number of Departmental seminar papers published as monographs and books which have become reference materials for both students and researchers in the field.

In the early part of the University's establishment, little or no attention was paid to inaugural lectures which made Faculty and Departmental seminar presentations more popular. In addition to that there were few professors then, who are qualified and competent to present the inaugural lectures. But today, there is hardly a Department that does not have more than two professors. Indeed, the challenge now is how to accommodate the increasing number of Professors in the presentation of the inaugural lectures.

Presently, the inaugural lecture has become an important and integral component of the University's academic activities which

was re-launched under the leadership of Professor Abdullahi Mustapha. The Committee responsible for the lectures was reactivated in 2013 and further strengthened in an effort to improve the presentation of the lectures. The University administration emphasized the importance of the inaugural lectures in the University to all stakeholders. As part of these efforts, the Administration instituted an award to each lecture presenter as a sign of its importance and significance in the University,which may also serve as a motivation for the Professors in the discharge of this important task.

Inaugural and public lectures are coordinated by the University's Organized Lectures Committee. The lectures were presented on a monthly basis during which a Professor from one of the Faculties/Departments in the University was sourced to present a lecture. The Committee is responsible for sourcing for the lecture presenters, processing the publication of the lecture after vetting the manuscript and handles all activities on the day of the lecture presentation.

Just like other activities in the University, the delivery of the inaugural lectures is saddled with some challenges especially those that affect academic activities in the University. These may include such as industrial action by in-house unions and/or students in the University. During the year under review, the academic activities of the University were suspended due to a National ASUU strike. Following the suspension of the strike, some arrangements were made to cover for the lost months. Despite this set back, a total number of twelve (12) lectures were delivered in 2014. The schedule for 2015 had already been drawn and arrangements have been put in place for its successful execution.

A total number of twelve (12) lectures were delivered in 2014. Therefore, this publication has twelve chapters with each chapter containing an inaugural lecture. The Chapters were arranged in the order that the lectures were presented. It is sincerely hoped and believed that the publication would serve the purpose for which it was initiated – an easy reference to some of the research works in the University.

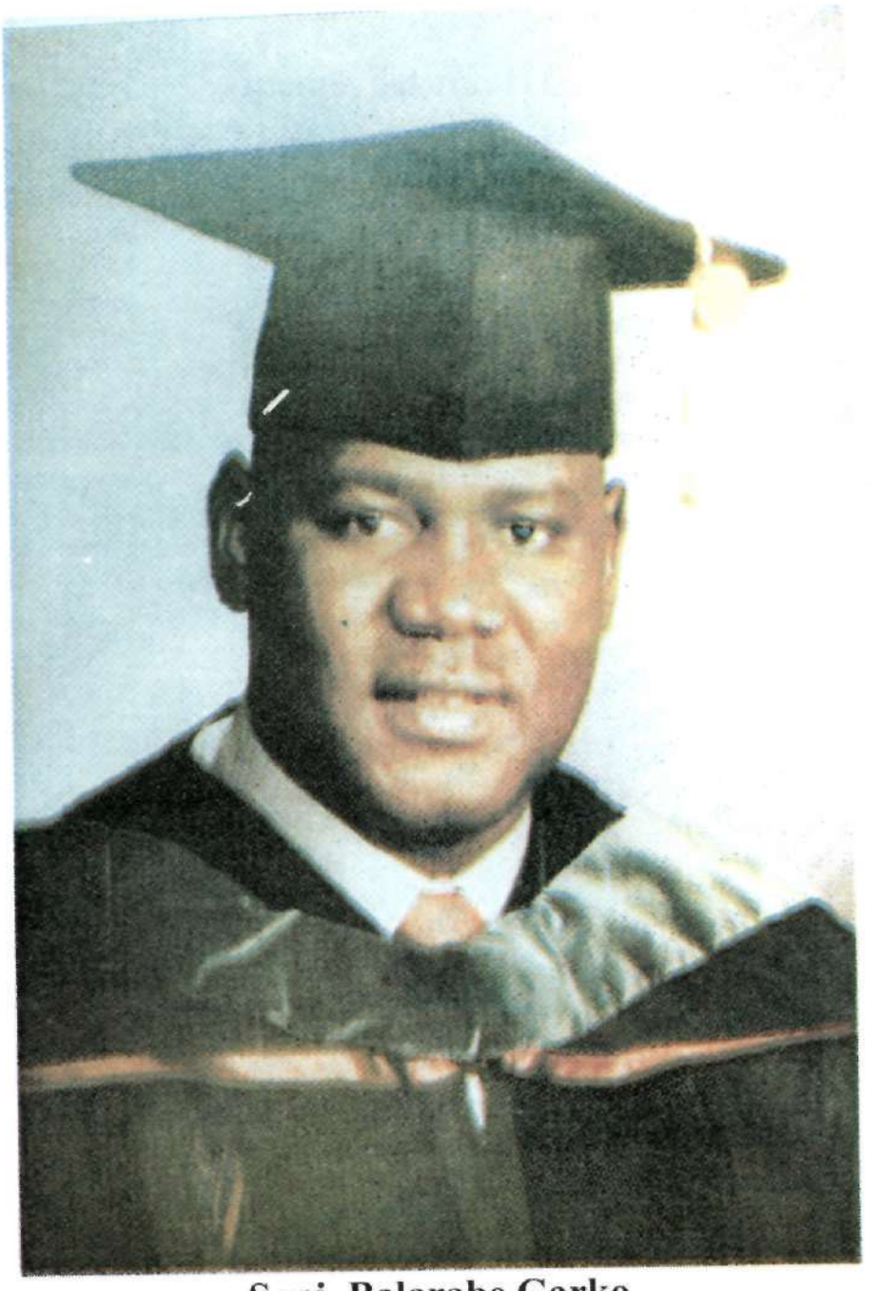
Chapter One

The Dilemma of Dealing with a Silent Enemy

The Dilemma of Dealing with a Silent Enemy

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Wednesday, 19th February, 2014



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Acknowledgements

I am most grateful to the Vice Chancellor of this great University, ABU Zaria, Professor Abdullahi Mustapha and the University organized lectures committee of ABU for this rare opportunity to deliver an Inaugural lecture. This is a chance for me to share some of my activities and modest contribution to my chosen field of endeavour.

I want to appreciate members of my Department, the Dept of Medicine, from my first encounter as a Medical Student in 1987, through my early postgraduate training to the present time. One cannot forget the names of Professor G.C Onyemelukwe(MON), Professor Adesanya,Professor CU Abengowe, Professor JU Okpapi, Professor Abdu-Aguye, Late Professor Onyewotu, Professor Lege Oguntoye,Professor AG Habib, Professor SS Danbauchi, Dr CN Ekweani, Dr CA Anyiam,Dr Mansur Kabir, Dr AI Dutse, Late Dr K Abdu-Gusau and a host of others too numerous to mention. You have all inspired me and contributed to the reality of today.

My colleaques now in the Department have been very supportive and understanding, My Head of Department and Dean Dr AG Bakari has been a wonderful brother and friend. I want to specifically appreciate the support and understanding from all members of the Department of Medicine.

I would like to appreciate key people who touched my life and contributed to my academic career outside ABU. Professor Falase, Professor Onadeko both from UCH Ibadan, Professor Obasohan AO from UBTH Benin City, Dr Yahaya Hashim and Dr Judith Ann Walker both of development research and projects consortium (dRPC), Kano, Ms Sandra McIntosh from the University of Witzwatersrand, South Africa where I went for the 'Methods Course' in 2005, Professor Navin Nanda, Director of the Heart Station in the University of Alabama, USA, where I did my visiting fellowship, Dr Sunil Mankad of the Mayo Clinic, USA. Professor KK Kapoor, Director of Non invasive cardiology at Apollo Hospital, India, Professor NN Khanna, Director of Vascular & Interventional Cardiology at Apollo Hospital, India, and Dr Alan Graham Stuart, Director of the Bristol Heart Institute, Bristol, UK.

I want to thank my patients from my first day in the hospital as a medical student to date. I am dedicating this lecture to all of you.

I want to thank my dear Family of Formation and of Procreation, my late Parents for all you have done to guide me through the most difficult path of early life. My brother Alhaji Sani Ali Garko, Sisters, other brothers, I am grateful. My immediate family have always been there and the kids have been wonderful friends at home.

I want to thank the almighty ALLAH for HIS mercy, guidance, protection and for making today to be part of my life.

Thank you.

I have been accused of many other things, but the views of others have never made me deviate from the path which I am certain is the one which will benefit my people and country. I have always based my actions on my inward convictions, on my conscience and on the dictates of my religion.

Late Sir Ahmadu Bello,
Sardauna of Sokoto
1960

It is a great honor to stand before you today to give this inaugural lecture on behalf of my department. The department of medicine, in the faculty of medicine. I must appreciate the dean, Dr. A.G. Bakari who nominated me on behalf of the faculty.

The last inaugural lecture given by my department was in 1996/97 by Prof. G. C. Onyemelukwe, my teacher and great mentor. I am therefore highly honored to follow in the footsteps of this great teacher so soon.

Mr Vice Chancellor Sir, distinguished guest, the title of my lecture may sound combatant, it is not meant to be so. The title was arrived at considering the issues I intend to discuss in terms of health and disease. It is common place to hear that this person died suddenly, that person developed a stroke suddenly, this person was well, and suddenly the doctors have told him he has a terminal disease. As a physician and a cardiologist, my practice has been shaped by experiences that would help us greatly in understanding some of these issues.

Mr. Vice Chancellor Sir, the topic for today evolves over a period of time through very tough and difficult process of selection of a topic that would reflect my thoughts over the years. I had thought of topics as ***"the Scourge of a silent killer in an under-developed economy"***, ***"the Emergence of Cardiovascular disease epidemic in developing countries"***, ***"the challenges of managing cardiovascular disease in Nigeria-on being the doctor"*** among others. I decided to present the topic as ***"THE DILEMMA OF DEALING WITH A SILENT ENEMY"*** not because it is a better title, but because I believe it will arouse our curiosity and stimulate our appetite to listen to what may be the contents of this talk today.

Mr. Vice Chancellor Sir, and distinguished listeners, I intend to take us through some select cardiovascular conditions and try to share the little I know about the challenges they pose both to the doctor and to the patient in Nigeria-where I trained and practiced.

The spectrum of cardiovascular disease that are of interest in this regard is wide, but I intend to restrict myself to:

1. Hypertension and its complication
2. HIV/AIDS and heart disease and
3. Heart disease of interest- PPCF and Takotsubo cardiomyopathy.

I implore you to follow me through as I share some of my experiences on these topics

1. Hypertension And Its Complications

Hypertension:

Hypertension, also known as high blood pressure, literally means a rise in the pressure (force) of circulating blood through our body. For us to remain healthy and grow, we need to nourish all parts of us. This is achieved by a network of pipes that carry blood all around our bodies and a return pipes that returns it to the central pump. This pump is the heart. The heart is endowed with the ability to initiate contraction independent of our state of mind in order to pump blood to the lungs to get oxygen and then pump the blood that has collected oxygen to the rest of the body. Oxygen is the gas needed for the body to be energized. The reason why I said, independent of our state of mind is that every part of the heart is capable of initiating and sustaining a heartbeat. As such Mr chairman people may go on hunger strike, may do a 'stay at home' strike, BUT NEVER ' stop the heart' strike, this is beyond the human ability, and I believe God, knowing the human mind, makes the working of the heart to be out of his control. The heart is wired with a special conducting system that discharges and initiates contraction. There are areas with different frequencies of discharge within the system with an inherent ability to inhibit each other, so that only the fastest determine heart rate at any given time. The heart beats about 60-100 times per minute and this beating starts from the womb and will only stop completely for a reasonable period after the organism is no longer living. The heart beats about 100,000 times a day, and about 3,000,000,000 times in an average lifetime.

As we all know, any pressure pump need a regulator just like injectors in our vehicle that are regulated by the amount of pressure on the throttle, which in turn determines whether we speed or go slowly. The heart and the blood vessels operate in such a way that all sizes of pipes and structures are perfused at a pressure that is not harmful to them. This is achieved by a complex regulatory mechanism. For example, if somebody is scared, the heart beats rapidly, the small blood vessels become smaller and blood is pushed to the brain, the eyes, and the muscles. This is to enable the body to function optimally for escape or to fight. This response is called the

'fight or flight' response. This is what is responsible for individuals achieving a feat that may appear extraordinary. At this point, that much bloods is pumped to the organs, the heart rate rises. By simple arithmetic of pressure being equal to force per unit area, the pressure rises and because the unit area in question is the cross sectional area of the blood vessel whose only variable is the radius.
Thus:- Borrowing from physics,

$$P = \frac{force}{Area}$$

$$BP = \frac{SV * HR}{\pi r^2}$$

SV = The amount of Blood pushed out at each heart beat
HR = the heat rate-number of heart beat per minute
π = constant
r = radius of the blood vessel

Thus, in the event of excitement, fear or stress, the pressure of blood flowing through our blood vessels rise. This rise is directly proportional to the heart rate, and stroke volume, and is inversely proportional to the radius of the blood vessel. From the above, you will agree with me that hypertension or high blood pressure is not necessarily a disease on its own. This is because, this transient rise in pressure will disappear as soon as the precipitant is removed.

When does a high blood pressure becomes a disease?

High blood pressure is defined as a sustained elevation in systolic blood pressure, diastolic blood pressure or both. Systolic blood pressure is the maximum force of blood in the arteries as the heart beats. Diastolic blood pressure is the force of blood in the arteries as the heart relaxes between beats.

A consistent reading of 140mmHg systolic and 90mmHg diastolic or higher is considered hypertension.

It is important that BP should be checked, on at least three separate consecutive occasions one week apart before a diagnosis of hypertension is made.

A patient presenting with known complication of hypertension or a history of being on drugs for hypertension may also be diagnosed hypertensive even if the BP is less that 140/90mmHg. When a patient present in heart failure - a condition

whereby, the heart in unable to pump blood at a sufficient pressure to ensure adequate tissue perfusion- the BP may be high, normal or even low. Thus, it is important to evaluate the patient making sure that other signs of long standing hypertension are absent before concluding that BP is normal.

Measuring Blood Pressure.

Blood pressure should be measured with the patient in a relaxed environment and the BP machine should be well maintained and properly calibrated.

In addition the following criteria should be observed for optimal records.

i. Measure sitting BP and additional standing BP in elderly and diabetics and those on anti-hypertensive therapy.
ii. Remove tight clothing from the arm.
iii. Support arm at the level of the heart.
iv. Use appropriate cuff size – bladder must encompass 2/3rd of arm.
v. Lower the mercury slowly.

The main problems with measuring BP are the technical errors and observer errors. It is always advisable; to have one person measures blood pressure. Reason being that observer error will be constant and thus insignificant. This means that the observer error will be constant, and with repeated measurement, a trend will be established.

Ambulatory and Home B.P Monitoring

This is recommended when we encounter any of the following conditions:-

i. Unusual variability of BP.
ii. White coat hypertension in people with low overall cardiovascular risk.
iii. Symptoms suggesting hypertensive episodes.
iv. Non-response to treatment of BP.

Casual BP - refers to BP recorded under ordinary condition in the physician office.

Basal BP -refers to reading obtained under condition of optimal physical and emotional relaxation such as in the patient's home.

Home blood pressure(Basal) measurements have been shown to be lower than readings obtained in the clinics(Basal) by several mmHg.

Repeated BP measurements will determine whether initial elevations persist and required close observations or whether they have returned to normal and need only periodic measurements.

Classification of Blood pressure levels.

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)
Optimal BP	<120	< 80
Normal BP	<130	<85
High-Normal	130-139	85-89
Grade 1 Hypertension (Mild)	140-159	90-99
Grade 2 Hypertension Moderate)	160-179	100-109
Grade 3 Hypertension (Severe)	≥180	≥ 110
Isolated Systolic hypertension	≥ 140	< 90

NB: when sBP and dBP fall into different categories the higher category should apply.

Causes of Hypertension

Hypertension in most people results from interplay between genetic and environmental factors. The factors that have been known to influence the development of blood pressure include:-

i. Hereditary
ii. Age
iii. Salt intake
iv. Obesity
v. Physical inactivity
vi. Excessive alcohol intake
vii. Stress
viii. Low potassium intake
ix. Low vegetable or fresh fruit content in the diet
x. High saturated fats contents in the diet

Some reports had identified additional risk factors in Nigerians and these include:-

- High and low socio-economic status

- High education level
- High income

Hypertension has no known cause in up to 98% of people who suffer from it. This is sometimes referred to as essential (primary) hypertension. This is where the genetic/ environmental interactions is implicated.

The remaining 2% cases of hypertension has a cause, and this is called secondary hypertension-See Figure I

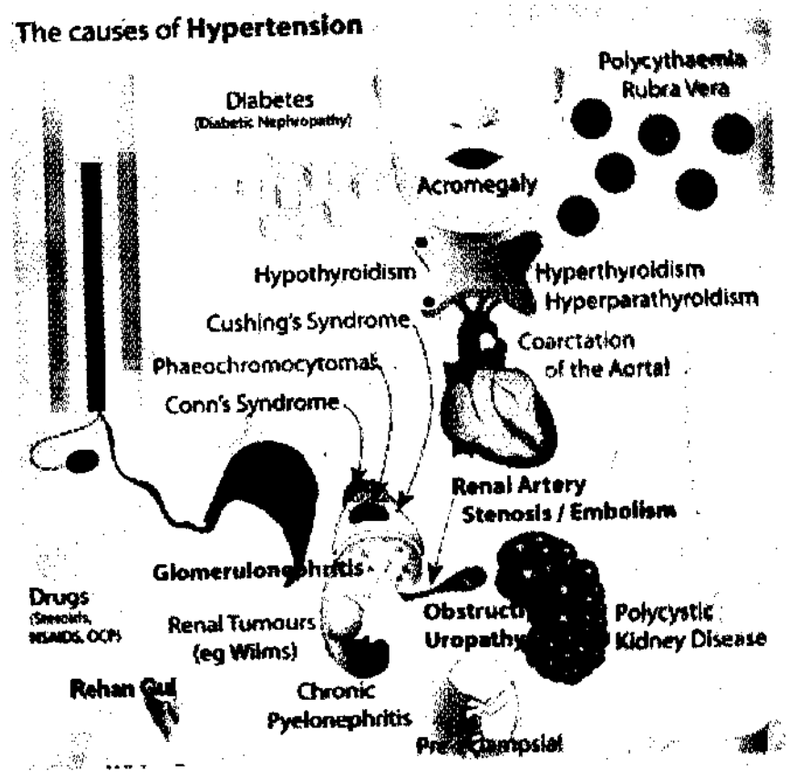


Figure I- Causes of secondary hypertension

Complications of Hypertension

The severity of complications is related to the height and duration of hypertension. Untreated long standing hypertension causes serious

complications in three important vital organs (commonly referred to as target organs*) **Heart, Brain and Kidney.***

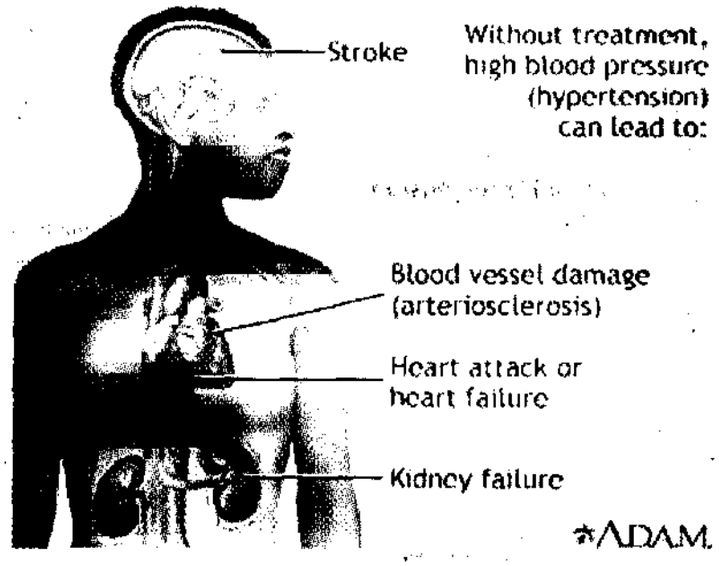


Figure 2- Complications of Hypertension

Elevated BP imposes excessive work on the myocardium and damages systemic arterial vasculature.

Hypertension affects the blood vessels in the body. Large arteries, small arteries and arterioles are not spared. The consequences are arteriosclerotic changes in large arteries and thickening of the walls of small arteries and arterioles.

Heart – The coronary arteries may be damaged and/or blocked, resulting in angina pains or heart attacks. The left ventricle may fail to perform its pumping function (LV failure)

The great vessels may be involved with Aortic aneurysm or Aortic dissection.

There may be uncoordinated beating of the heart (referred to as arrhythmias), this may result from dilated heart chambers especially left atrium or from damage to the conduction system in the heart.

Brain and Nervous System.

The Brain and nervous system is affected because elevated BP breaks down the normal cerebral auto regulation. Normally, when BP rises, cerebral arterioles vasoconstrict and cerebral blood flow (CBF) remains constant.

In hypertensive emergency, the elevated BP overpowers arteriolar control and auto regulation of CBF, this results in transudates leak across the capillaries and continued arteriolar damages with consequent cerebral edema. This lead to cerebral malfunction referred to as encephalopathy. In the event of this happening, the patient may present with:-

- Vomiting, headache, convulsion (seizure), loss of consciousness and focal neurologic deficit like hemiplegia, blindness, aphasia and papilledema.

Kidneys

Damages to small arteries and arterioles in the kidney lead to malfunction of the kidneys manifesting as leakage of proteins and other vital components of the blood in urine.

This result is progressive renal failure, end stage renal disease and nephrosclerosis.

Kidneys may also be damaged from drugs taken for various ailments sometimes even to treat the hypertension itself. The challenge is that kidney damage often time does not manifest till it is late.

Management of Hypertension

The most important step in proper management of hypertension is proper evaluation of the patient including adequate history, physical examination and laboratory tests. The overall cardiovascular risk should be assessed including determining target organ damage and presence or absence of co-morbid conditions. Hypertension management must be individualized as much as possible.

The overall strategy for optimum management of hypertension should include:-

i. Determination of the level of cardiovascular risk
ii. Lifestyle measures should be offered to all patients and
iii. The decision to initiate drug therapy must be made according to laid down guidelines and in consultation with the patient.

The lifestyle measures that have been shown to reduce BP include:-

- Reduction in salt intake
- Weight reduction
- Increased physical activity
- Moderation in alcohol intake - *indeed for African heart that is prone to hypertensive heart failure- a mechanical failure- any amount of alcohol has been shown to be detrimental.*
- Increase in dietary potassium intake and
- Intake of diet with increased fresh fruits and vegetables and reduced saturated fat intake – DASH diet

Lifestyle measure are less expensive than drug therapy, they are without adverse effects and it improves the sense of wellbeing of the patient.

The primary goal of treating hypertension is to achieve the maximum reduction in the total risk of cardiovascular disease. This requires that, apart from treating the BP, all identified modifiable risk factors must be addressed.

The hypertension optimal treatment trial (HOT) showed significant reduction in mortality when BP was reduced to levels below 140/90mmHg. In patients who have diabetes and renal disease, the BP should be reduced to below 130/80mmHg.

Prevention of Hypertension

This can be achieved at various levels.

Primordial prevention: - This is aimed avoiding those social, economic and cultural patterns of life that have been shown to contribute to the high incidence of the disease.

Primary prevention: - This is aimed at reducing or modifying risk factors already present in the individual and the community and fore stalling the development of overt disease.

Secondary and Tertiary prevention: - these involve the management of the disease and complications of the disease.

Cardiovascular disease risk factors in Nigeria

There had been so many studies on hypertension in Nigeria, putting the prevalence of hypertension at 10-12% in 1991(Non communicable disease study, FMOH). Some studies got prevalence of hypertension as high as 30%.

We studied the prevalence of risk factors for cardiovascular disease among apparently healthy Hausa Fulani Nigerians. The study was to compare and contrast between residents of an urban and a rural area. A total of 276 subjects were recruited for the study, [138 from the urban and 138 from the rural areas].

Cigarette smoking and alcohol intake were found to be uncommon among the elderly Hausa-Fulani population. The women were found to be largely inactive [sedentary] whereas the men, both urban and rural were found to be physically more active than the women, especially in the rural areas. The mean fasting plasma cholesterol for the study population was 4.7 4± 1.32mmol/L and the mean total triglycerides was 1.70 ± 0.58 mmol/L. The mean total fasting plasma glucose was 4.08 ± 1.58 mmol/L. Two(2=0.7%] subjects were found with overt diabetes and 10[3.6%] subjects had fasting total cholesterol greater than 6.2mmol/L. There was no significant difference between the mean diastolic blood pressures of the urban and rural areas, but the systolic and mean blood pressures differ significantly.

There is a significant correlation between blood pressure [systolic and diastolic], age and physical activity among the study subjects.

A more significant cluster of CVD risk factors was seen among the urban subjects whereas the women had a more significant cluster of the risk factors [high blood pressure, obesity, increased fasting plasma glucose, and family history of hypertension, stroke or diabetes] compared to the men. It is therefore suggested that physical activity, weight reduction and

dietary advice among the susceptible urban and rural elderly population, particularly post menopausal women should be encouraged.

Below is a summary of our findings from the study.

1. **Age:** The subjects were grouped into three age categories: 55-59, 60-64 and 65 years and over. Of the 276 subjects studied, 98[35.5%] were aged 55-59 years, 68[24.6%] were aged 60-64 years while 110 [39.9%] were aged 65 years and over. Seventy eight women were studied, 35 [44.9%] were aged 55-59 years, 18[23.1% were aged 60-64 years and 22 [28.2%] were aged 65 years and over. A total of 198 men were studied, 63[31.8%] were aged 55-59 years, 50[25.3%] were aged 60-64 years and the rest 88[44-4%] were aged 65 years and over.

   There were similar age distributions between the men and women such that age should not therefore compound the interpretation of the differences in the results between the two sexes.

   A total of 138 subjects were studied in each area [urban and rural] and the percentage distribution within the three age groups was similar.

2. **Physical Activity:** 29% of the study subjects were sedentary while 71% were non-sedentary. 14% and 67% of the men and women respectively were sedentary, while 86% and 33% of men and women respectively were non-sedentary. This indicates that the women had greater tendency towards increased physical inactivity compared to the men. The physical activity rating also showed that 30% and 28% of urban and rural subjects respectively were sedentary while 70% and 72% of urban and rural subjects respectively, were non-sedentary. These levels of physical activity showed a slightly greater tendency towards physical activity in the rural subjects compared to their urban counterparts.
3. **Cigarette Smoking:** Only 2 subjects each from the urban and the rural areas admitted being smokers. This constitutes 1.4% smoker prevalence in both urban and rural areas.

4. **Alcohol Intake:** None of the subjects studied admitted consumption of any form of alcoholic beverage. This may have to do with cultural and religious practices of the study population.
5. **Family History of Hypertension:** 17 [6.2%] of the studied subjects were aware of hypertension cases in their first degree relatives. 14[7%] men and 3[1.8%] women had positive family history of hypertension. 10[7%] and 7[5%] of urban and rural subjects respectively had positive family history of hypertension.
6. **Family History of Diabetes:** Only 5 [1.8%] of the studied subjects indicated a positive family history of diabetes. 3[1.5%] men and 2[2.6%] women were award of a first degree relative who is diabetic. 2.2% and 1.4% of the urban and rural subjects respectively had a positive family history of diabetes.
7. **Family History of Stroke:** 12[4.3%] of the entire subject had a family history of stroke. 9[4.5%] men and 3[3.8%] women had a family history of stroke. 5.1% and 3.6% of the urban and rural subjects respectively had a family history of stroke.
8. **Family History of Sudden Death:** 9[3.3% of the study subjects admitted a family history of sudden death. 8[4%] men and 1.1.3%] woman had a positive family history of sudden death. All the subjects with a family history of sudden death were from the rural area.

Table 1:

Prevalence of Non-Quantifiable CVD Risk Factors

RISK FACTORS	ALL n=276 (%)	MALE n=198 (%)	FEMALE N=78 (%)	URBAN n=138 (%)	RURAL N=138 (%)
Cigarette	4 (1.4)	4 (4.2)	0	2 (1.4)	2 (1.4)
Alcohol	0	0	0	0	0
FHx Hypertension	17 (6.2)	14 (7.1)	3 (3.8)	10 (7.2)	7 (5.1)
FHx Diabetes	5 (1.8)	3 (1.5)	2 (2.6)	3 (2.2)	2 (1.4)
FHx Stroke	12 (4.3)	9 (4.5)	3 (3.8)	7 (5.1)	5 (3.6)
FHx Sudden Death	9 (3.3)	8 (4.0)	1 (1.3)	0	9 (6.5)
Physical inactivity Sedentary	80 (29.0)	29 (14.1)	52 (66.7)	41 (29.7)	39 (28.3)
Non-Sedentary	196 (71.0)	170 (85..9)	26 (33.3)	97 (70.3)	99 (71.7)

Age Category 55 – 59 Years	98 (35.5)	63 (31.8)	35 (44.9)	49 (35.5)	49 (35.5)
60 – 64 Years	98 (24.6)	50 (25.3)	18 (23.1)	33 (23.9)	35 (25.4)
65 Years and over	110 (39.9)	88 (44.4)	22 (28.2)	56 (40.6)	54 (39.1)

Table 1 shows the prevalence of non-quantifiable risk factors among the study subjects.

Prevalence of Quantifiable CVD Risk Factors In The Study Population [Table 2 And 3]

1. **Hypertension:** Most of the subjects were non-ostensive. However, some overt hypertensive was seen. Of the 276 subjects studies, 53 [19%] had borderline hypertension, 21[7.6%] had mild hypertension, 13[4.7%] had moderate hypertension and 3[1%] had severe hypertension. All the 3 subjects with severe hypertension were females from the rural area. 20[10%] of the males had mild to moderate hypertension while 14[17.9%] of the women had mild to moderate hypertension.
2. **Obesity:** Though the mean BMI [+SE] value for all the subjects is 22.81 + 3.53, 6[2.2%] subjects were obese. 2[1%] men and 4[5%] women were obese. 4[2.9%] and 2[1.4%] urban and rural subjects respectively were obese. Of the 10[3.6%] men who were overweight, 4[2.9%] and 6[4.3%] reside in the urban and rural areas respectively. 11[8%] of the 17[6.2%] women who were overweight are from the rural area whereas the rest 6[4.3%] reside in the urban area.
3. **Truncal Obesity:** 44[31.9%] of the 77[27.9%] men who were truncally obese were from the rural area and the rest 33[23.9%] reside in the urban area. Furthermore 40[29%] of the 67[24.3%] women who were truncally obese reside in the rural area while the rest 27[19.6%] are from the urban area. It should be noted here that the mean WHR of the rural subjects was higher than that for the urban subjects.
4. **Diabetes:** There were only 2 subjects whose serum fasting plasma glucose was greater than 7.8mmol/L. Both of them are men from the urban area.
5. **Hypercholesterolemia:** 10[3.6%] subjects had fasting serum cholesterol more than 6.2mmol/L. 5[2.5%] and 5[6.4%] were men and women respectively. Six of the 10 subjects were from the rural area whereas 4[2.9%] were urban residents. The mean fasting plasma cholesterol for the study population is 4.71 + 1.32mol/L [Tale 3].

6. **Hypertriglyceridemia:** 2 [0.7%] of all the subjects had plasma fasting triglyceride of more than 3.0mmol/L. Both are men, one each from the rural and the urban areas. This conforms to the low mean value of fasting plasma triglyceride of 1.70 + 0.58mmol/L.

Table 2:

Prevalence of Quantifiable Risk Factors

RISK FACTORS	ALL n=276(%)	MALE n=198 (%)	FEMALE n=78 (%)	URBAN n=138 (%)	RURAL n=138 (%)
Hypertension:	53 (19.2)	39 (19.7)	14 (17.9)	23 (16.7)	30 (21.7)
- Borderline					
- Mild	21 (7.6)	11 (5.6)	10 (12.8)	14 (10.1)	7 (5.1)
- Moderate	13 (4.7)	9 (4.5)	4 (5.1)	9 (6.5)	4 (2.9)
- Severe	3 (1.1)	0	3 (3.8)	0	3 (2.2)
Obesity:					
- Lean (<20kg/m2)	50 (18.1)	32 (16.2)	18 (23.1)	28 (20.3)	22 (15.9)
- Obese (>30kg/m2)	6 (2.2)	2 (1.0)	4 (5.1)	4 (2.9)	2 (1.4)
Overweight:					
- Male (>27. 30kg/m2)	10 (3.6)	10 (5.1)	0	4 (2.9)	6 (4.3)
- Female (25. <30kg/m2)	17 (6.2)	0	17 (21.8)	6 (4.3)	11 (8.0)
Truncal Obesity					
- Male WHR (>0.94)	77 (27.9)	77 (38.)	-	33 (23.9)	44 (31.9)
- Female WHR (0.87)	67 (24.3)	-	67 (85.9)	27 (19.6)	40 (29.0)
Abnormal FPG / Diabetes					
- FPG > 7.8mmol/L	2 (0.7)	2 (1.0)	0	2 (1.4)	0
High Cholesterol Total Cholesterol > 6.2mmol/L	10 (3.6)	5 (2.5)	5 (6.4)	4 (2.9)	6 (4.3)
High Triglyceride	2 (0.7)	2 (1.0)	0	1 (0.7)	1 (0.7)

Table 3:

Anthropometric and Biochemical Features for the Study Population

RISK FACTORS	ALL n=276	MALE n=198	FEMALE n=78	URBAN n=138	RURAL n=138
Weight (Kg)	58.40 ±9.75	59.70±9.06	55.12±10.69	59.11±10.99	57.70±8.31
Height (m)	1.60±0.08	1.62±0.08	1.54±0.06	1.62±0.08	1.58±0.08
BMI (Kg/m2)	22.81±3.53	22.70±3.18	23.09±4.31	22.43±3.64	23.19±3.39
WC (cm)	81±1.0	80±0.9	82±1.1	82±1.0	79±0.9
HC (cm)	87±1.0	86±0.8	89±1.3	89±0.9	84±1.0
WHR	0.93±0.06	0.93±0.06	0.93±0.05	0.92±0.06	0.94±0.05
dBP (mmHg)	84.64±10.74	83.46±9.99	87.64±12.00	85.49±10.87	83.80±10.53
sBP (mmHg)	137.15±123.89	134.66±22.94	143.46±25.21	140.12±24.65	134.18±22.81
Total Cholesterol (mmol/L)	4.71±1.31	4.67±1.08	4.80±1.83	4.58±1.16	4.84±1.47
Total Triglyceride (mmol/L)	1.70±0.58	1.69±0.58	1.75±0.59	1.63±0.59	1.78±0.57
FPG (mmol/L)	4.08±1.58	3.90±1.61	4.56±1.40	4.42±1.73	3.73±1.34

Table 4:

Correlation/Partial Correlations

Table 4 shows the relationship between the different CVD risk factors in the study population. Body mass index was significantly related to total cholesterol. BMI is also significantly related to Triglycerides for the rural population. There was a significant correlation between WHR and Triglycerides, Total cholesterol and fasting plasma glucose. These relationships are also seen among males, females, rural and urban subjects studied. The critical value for the correlation coefficient [Cr] for the all the subjects is 0.134.

TABLE 4: showing correlation between Blood pressure and risk factors.

RISK FACTORS n Corr. Coef (Cr)	ALL n=276 0.134	MALE n=198 0.164	FEMALE n=78 0.260	URBAN n=138 0.190	RURAL n=138 0.190
BMI vs dBP	0.10	0.10	0.08	0.02	0.02
sBP	0.03	0.02	0.02	0.18	0.12
FPG	0.05	0.13	0.05	0.16	0.18
T-Chol	0.20*	0.16	0.28*	-0.05	0.41*
TG	0.07	0.16	0.06	0.18	0.30*
WHR vs dBP	0.05	0.04	0.08	0.09	0.03
sBP	0.01	0.04	0.08	0.07	0.00
FPG	-0.18*	-0.07	-0.63*	-0.03	-0.46*
T-Chol	0.14*	0.42*	0.04	0.48*	0.34
TG	-0.14*	-0.18*	-0.01	-0.05	0.30*

Cr – Critical value of the correlation coefficient.

- Significant at $P<0.05$

Studies from other parts of the country also shows that, the prevalence of hypertension and other risk factors for cardiovascular disease is high in all parts of Nigeria (Obasohan & Ajuyah). The prevalence is higher in urban compared to rural areas of the country.

The high incidence of hypertension and it's complications has been largely attributed to poor medication adherence among the patients. We had looked at the factors that determine medication adherence in Northern Nigeria. We studied this among our patients living with HIV/AIDS.

Mr Vicé Chancellor Sir, Please permit me to present a summary of our findings as it relates to treatment adherence.

Factors Affecting Antiretroviral Treatment Adherence in Abuth Art Clinic Kaduna

Introduction

Clinical benefits of ART has been dramatic, fewer people now progress to AIDS. There has been more than 70% decline in age adjusted death rate from HIV/AIDS. Adherence to ART is a major determinant of successful ART programs. Adherence is 2nd strongest predictor of progression to AIDS and death after CD4 count . Suboptimal adherence results in treatment failure. Failure can be clinical, immunologic or virologic, long term viral suppression requires a near perfect adherence Drug-resistant strains of HIV are selected through ongoing replication in the presence of suboptimal ART.

Infection with such strains leaves fewer treatment options from the outset

Other determinants of ART failure or success include :-

- genetic differences in drug metabolism
- severe baseline immune suppression
- prior drug resistance and
- concurrent opportunistic infections.

Adherence to ART, however, is one of few potentially alterable factors determining outcomes for patients with HIV.

Medication adherence

The extent to which a patient takes a medication in the way intended by a health care provider.

Adherence and non adherence are meant to be

Nonjudgmental statements of fact rather than expressions of blame toward the patient or provider.

Non adherence to medication, in general, is very common.

Typical adherence rates for medications prescribed over long periods of time are approximately 50-75%.

Poverty and adherence:-

Direct effect of poverty on adherence is not adequately documented.

Wide ART access is recent in resource poor settings such as Nigeria and other developing countries. Biomedical research rarely examine the biosocial context in which patients live.

Burdens substantiated by previous workers include:-

The cost of missing work, the cost of transportation to a health centre, the cost of user fees and cost of tests and supplies .

Adherence Measurements

This can be achieved by:- patient's **self-report** of pill-taking behavior or measures that are **objective surrogates** of pill-taking behavior(***pill count, MEMS caps-****medications event monitoring system)*

General objective:-

To understand the social factors affecting antiretroviral treatment adherence in ABUTH Kaduna.

Specifically:-

- *To explore factors such as Social and personal experiences ,*
- *Effects of Stigma,*
- *Disclosure and Support ,*
- *Effects of Psychosocial Concerns, eg depression, psychosis, isolation,*
- *Effect of the use of Alternative/Complementary Medicines*
- *Patient knowledge of his conditions*
- *a good understanding of ART and*
- *Geographic access*

On patient's adherence to ART

Methodology

The study was a descriptive cross-sectional study

A patient must have been on the treatment for at least six months before they qualify to be enrolled for the study.

The list of all People Living With HIV/AIDS(PLWHA) on treatment constituted the sampling frame,

The sample size for the study at 95% confidence allowing for 5% degree of accuracy was calculated to be 73

An error margin of 10% was considered to cover for:-
invalid questionnaires, non response and other issues related to data collection,
This made up the sample size to 80 PLWHAS.
Sample selected using simple random technique

Inclusion criteria

- Ambulant person on ART for a minimum of 6 months.
- Has to be 18 years or over, male/female who gives an informed consent for the study
- Should not be moribund and
- Should not be a volunteer

Exclusion criteria

Those excluded from the study are:-

- Moribund patients
- Those with serious illnesses requiring admission
- Children and
- Volunteers

Questionnaires were administered by self or by a trained staff.

Limitations of the Study

- Problems of recall, for drugs missed or taken late
- It was difficult to ascertain some problems at home that affect compliance as the data was collected in the clinic.
- ?Reliability of the information
- A cross sectional study like this one may not unravel all the factors affecting compliance, an ethnographic study probably prospective, employing other modalities of assessing compliance such as the pill count or the Medication Event Monitoring System(MEMS) may yield a more useful data.

Results

A total of eighty (80) questionnaires were administered to PLWHA
Seventy three (73) questionnaires were valid and used for the study among those returned.
Thus 73 PLWHA's (28males and 45 females) participated in the study.

TABLE 5
Age – Sex Distribution of Respondents

AgeGroups Yrs	Gender		TOTAL	%
	Male	Female		
20-34	13	24	37	50.7
35 – 49	14	20	34	46.6
50 – 64	1	1	2	2.7
TOTAL	28	45	73	
%	38.4	61.6		100

Fourty five (62%) are aged 20 – 49years, 3% of them aged 50years and over.
42 (57.5%) respondents had completed secondary school
22(30.1%) had completed post secondary education.
Seventy (95.9%) reside in Kaduna state
Most respondents are gainfully employed
28 (38.4%) respondents however reported that, they had no income generating job.

Adherence assessment
Fourteen (19.2%) respondents reported missing pills during the interview.
Compliance rate of 80.8%.

Knowledge of the Antiretroviral drugs among respondents
Fifty five (75.3%) have correct knowledge of the drugs they are taking. This was assessed by their ability to name or identify their drugs and state how exactly they take each drug every day.

TABLE 6- Knowledge of drugs

Knowledge of drugs	**No**	**%**
Correct	55	75.3
Incorrect	6	8.2
No response	12	16.4
Total	**73**	**100**

Table 6 shows the result of assessments of the respondent's knowledge of the ART. This was assessed by naming the drugs or identifying the packets. Respondents are then asked to explain how the drugs are taken. Fifty five respondents demonstrated correct knowledge of the ART while 12 respondents did not respond. Six respondents could not demonstrate good enough knowledge of the ART.

Adherence Assessment

Adherence was assessed using the 3 day recall and among the respondents 1(1.4%) reported missing a dose the previous day, 3(4.1%) reported missing pills 2 days prior to the interview. Among the reasons given for missing doses are:- Drugs got finished, forgetting to take the pills, travel, lack of money, too much work and slept off due to tiredness. Most of the missed pills (35.7%) were due to drugs getting finished. Twenty six (35.6%) of respondents reported ever missing pills due to shortage of supply.

TABLE 7-Missed Pills yesterday (a day before interview)

Response	**No**	**%**
Yes	1	1.4
No	**72**	95.9
Total	**73**	**100**

Table 7 assesses the number of people who missed pills a day before the interview. One respondent missed pill a day before the interview.

TABLE 8-Missed Pills two day before interview

Response	**No**	**%**
Yes	**3**	4.1
No	70	95.9
Total	**73**	**100**

Table 8 shows missed pills two days before the interview. Seventy respondents which is upwards of 95% did not miss any pill 2 days before the interview.

TABLE 9-Missed Pills 3 days before interview)

Response	No	%
Yes	10	13.7
No	63	86.3
Total	**73**	**100**

Table 9 shows that up to 86% of respondents did not miss pills 3 days before the interview. Ten respondents indicated that they missed pills 3 days before the interview.

TABLE 10- Missed Pills last month

Response	No	%
Yes	5	6.9
No	68	93.1
Total	**73**	**100**

Table 10 shows how many respondents missed pill in the last month before the interview. More than 90% of the respondents did not miss pill in the last one month. This question was put to those who reported not missing any dose in the three days preceding the interview.

TABLE 11-Reason for missing pills

Response	No	%
Drug got finished	5	35.7
Forget	3	21.4
Traveled	2	14.2
Lack of money to buy	1	7.1
Slept off, too tired	2	14.2
Too much work	1	7.1
Total	**14**	**100**

Table 11 shows the various reasons given by those who missed pills. Mostly the reasons given include drugs got finished, forgetting, and lack of money to buy drugs among other reasons.

Twenty eight (38.4%) had experienced side effects from the medication which included: diarrhea, dizziness, hunger after taking

drugs, nausea, rashes and body pains. This did not however make them to discontinue drugs as only 5(6.8%) had to stop drugs because of side effects.

This compliance rate is comparable to reports from South Africa (87.2%), United States (63%), Ivory Coast (58%) and Spain (58.8%).

HIV Status Disclosure

Sixty (82.2%) had disclosed their status to someone else

The disclosure was to family members mainly such as brothers, husband, mother, wife, parents and the like.

Disclosure brought feeling of relief in 17 (28.3%) respondent, 11(18.3%) felt indifferent after disclosure while 6(10%) felt ashamed of themselves.

Reasons given by those who did not disclose their status include; to avoid stigmatization, fear of discrimination and wanting to keep it secret.

Poverty and adherence to ART

Apart from money for ART, respondents indicated that they need money for food, transport to the health facility, vitamins and other needs.

In spite of these, 48(65.8%) said there are times they do not have the N1000=00 for ART at the clinic.

Distance from home to clinic as a determinant of adherence

While some reside inside Kaduna town others had to travel 80-100km (a journey that takes 1-2 hrs by bus to access the treatments).

43 (58.9%) travel for between 1 &2 hours to reach the clinic for drugs.

The fact that over 60% of respondents report that there are times they do not have the N1000 for ART further confirms the fact that poverty significantly affects access to ART in our setting.

Discussion

ART has transformed HIV infection into a stable chronic condition.

The need to continue treatment for decades rather than years calls for a long-term perspective of ART.

Adherence to the regimen is essential for successful treatment and sustained viral control.

Reasons for non-adherence

Many reasons are given worldwide, these include:-

- pill fatigue,
- side effects and
- decrease in severity of disease.

Reasons proffered by respondents for their inability to adhere include

- non-availability of drugs (35.7%),
- forgetfulness (21.4%),
- lack of funds (7.1%),
- busy schedule (7.1%) and
- travelled (14.2%).

These reasons are similar to the reasons reported by Z. Iliyasu et al in Aminu Kano Teaching Hospital, Kano

Poverty and adherence

Our respondents indicated that they need money for
food, transport to the health facility, to buy vitamins and other needs in addition to the money needed monthly for ART.
This is coupled with the fact that most of our respondents are the primary breadwinners in their families.

Way forward

Addressing adherence may require:-

- Providing social support to patients;
- Lowering or eliminating user fees;
- Bringing health care workers closer to patients;
- Opening health centres focused on patients' competing demands to survive;
- Improving drug procurement strategies, and

- Creating mechanism for lowering the cost of drugs and laboratory services.
- Way forward
- This will in many cases, mean improving and investing in primary health care, public Hospital, and referral networks.
- There is also need to recruit and retain health care workers committed to serving their patients.

Conclusion

In view of this complex interrelated factor, the possibility of advancing the understanding of the multifaceted causes of non adherence needs to be analyzed within its larger social, economic and political context.

Mr Chairman Sir, we had also reviewed the literature on a very important reason why people with hypertension may not stay on the prescribed treatment, especially the male patient. This problem is the problem of Erectile dysfunction. Permit me Mr Chairman to present a summary of our findings:-

Sexual Dysfunction In Hypertensive Patients: Implications For Therapy

Sexual dysfunction associated with hypertension or antihypertensive therapies may impact the ability of patients to stay on therapy and lead to deterioration in patients' quality of life.

Penile erection, occurs in response to the activation of proerectile autonomic pathways, this greatly depends on adequate inflow of blood to the erectile tissue and requires coordinated arterial endothelium-dependent vasodilatation and sinusoidal endothelium-dependent corporal smooth muscle relaxation(Anderson & Wagner 1995). Nitric oxide (NO) is the principal peripheral proerectile neurotransmitter that is released by both nonadrenergic, noncholinergic neurons and the sinusoidal endothelium, to relax corporal smooth muscle through the cGMP pathway (Azadzoi 1992, Ignarro 1990), resulting ultimately in increased intracavernosal blood flow and pressure(ICP). This increase in ICP activates pressure-dependent veno-occlusive mechanisms to limit the outflow of blood, thus further promoting elevated ICP and erectile response. The increased blood flow is thus ultimately driven by the force of the arterial pressure. Any factors

modifying the basal corporal tone, the arterial inflow of blood to the corpora, the synthesis/release of neurogenic or endothelial NO within the corpora and/or the veno-occlusive mechanism are prime suspects for being involved in the pathophysiology of ED.

Therefore, it is important for practitioners to become familiar with the wide variation in sexual side effects produced by antihypertensive agents and to discuss the potential occurrence of these side effects with their patients. In many cases, a change in the patient's drug regimen may help patients overcome specific sexual side effects experienced with certain drugs. Practitioners should consider selecting an antihypertensive therapy that is highly effective in lowering blood pressure and at the same time preserves patients' quality of life. The effect of medications on sexual function remains controversial. Some blinded trials report little difference between placebo and specific medications, whereas other studies indicate that antihypertensive medications increase sexual dysfunction, which has an impact on quality of life. Recent evidence suggests that losartan, an angiotensin II antagonist, is not typically associated with development of sexual dysfunction and may actually positively impact several indices of sexual function (erectile function, sexual satisfaction, and frequency of sexual activity) as well as perceived quality of life. Thus, angiotensin II antagonists may offer a therapeutic option to prevent or correct erectile dysfunction in patients with hypertension. The favorable effects of these agents on sexual function may be related, in part, to their ability to block angiotensin II, which has recently become recognized as an important mediator of detumescence and possibly erectile dysfunction.

Heart Diseases of Interest in Nigeria

Mr. Vice Chancellor Sir, before I conclude, I will want to touch a little about 2 other heart disease that are relevant to our practice in Nigeria today.

i. **Peripartum Cardiac Failure (PPCF)**

The syndrome of peripartum cardiac failure (PPCF) has been described in the American Negro since the 1930s. It was first described in Nigeria from Zaria in 1974 by Prof. E. H. O. Parry and his colleagues in A.B.U Teaching Hospital Zaria. The only other place PPCF was described then was in Ibadan, South-West

Nigeria. This is a syndrome of heart failure that comes on some weeks before delivery or within six months of child birth. The syndrome was found to be common in the areas of Hausa majority mostly around Zaria and Malumfashi, where post-partum practices of taking hot baths, lying on hotbed, and taking large amounts of Kanwa (a lake-salt rich in sodium) are pursued with great vigour. These customs impose a critical load on a vulnerable myocardium with consequent heart failure. It seems that tribe and tradition could well explain the high incidence of PPCF around Zaria.

In our cardiac clinic today, sir, 70-80 percent of our patients are women and majority of them started coming to the clinic as a result of pregnancy/childbirth related heart diseases. The commonest ailment seen in our clinic being hypertensive heart disease, rheumatic valvular heart disease, peripartum cardiomyopathy and other forms of cardiomyopathies such as caused by HIV/AIDS.

Mr Vice Chancellor sir, permit me to share a summary of our report of a fatal case of a woman who came to our hospital in labour with hypertensive heart failure.

CASE REPORT-Hypertensive heart failure presenting in Labour

S.L. a 30yrs old woman ($para^{0+1}$) was referred from a peripheral clinic in labour after nine (9) months gestation, with symptoms of pulmonary oedema to our centre. She had booked in the same clinic at the gestational age of 5 months, with no apparent problem. She was noted to have developed high blood pressure about a month before referral to us. She had a laparotomy for ectopic pregnancy 10 years prior to presentation.

This pregnancy is the second in 10 years. No family history of hypertension, diabetes, or sudden non-mechanical death.

Physical findings on admission include:- respiratory distress (RR=40/min). mild central cyanosis, bilateral pitting pedal oedema, tachycardia of 126 beats per minute, displaced apex beat to the left 6^{th} intercostals space, lateral to midclavicular line, raised jugular venous pressure (JVP), loud A2 component of S2 and a third heart

sound. She also had widespread bilateral crepitations at the lung bases. She had an enlarged tender liver 6cm below the right costal margin with a span of 16cm. Fundoscopy was not done.

Her blood pressure was 190/120 mmHg. Her abdomen was gravidly distended with intermittent uterine contractions. She was also confirmed to be in labour by the attending obstetrician and gynecologist, the cervical os was 6cm dilated and the cervix was fully effaced. She was conscious and oriented. An impression of acute pulmonary oedema from hypertensive heart failure was made. She was started on furosemide 120mg intravenously (i.v) stat, then 80mg given i.v. every 12 hours, intermittent hydralazine given as 20mg i.v slowly over 10 minutes stat, then 20mg slowly, 4 hourly till diastolic blood pressure became less than 110mmHg, oxygen by face mask, intravenous cefriazone 1gm daily and intravenous bolus of 50% dextrose 30ml stat. Her blood pressure was 180/120mmHg, 8 hour after admission. She was being assessed by the gynaecologist regularly to assess the progress of labour.

Urinalysis showed no proteinuria, urine microscopy result showed no red cells, 2-4 white cells per high power field and no casts. Her random blood sugar was 7.4mmol/litre, blood count showed packed cell volume of 39%, a normal white cell count of 4100 with neutrophils of 58% and lymphocytes of 42%. Urea was 8.4mmol/1. Na^+ 140mmol/1, potassium 4.0 mmol/l, chloride 98 mmol/l, bicarbonate 24mmol/l and creatinine 90 umol/l. She made 1500 ml of urine in the first 6 hours of admission. Her condition remained poor. After 12 hours on admission, the patient died. The fetal heart sounds could not be picked 2 hours before she died.

Discussion

Cardiovascular disease is an important non-obstetric cause of maternal death. The physiologic changes in cardiovascular system during pregnancy influence cardiac disease in different ways. The mechanism involved in arterial hypertension and pre-eclampsia of pregnant women are presently very well known, including genetic causes, alterations on the rennin-angiotensin systems, imbalance between vasoconstrictor and vasodilator agents derived from endothelial activity of the spiral arteries of the placenta, such as prostacylins, thromboxane A2, Nitric Oxide and endothelin-1 among othes.

Pre-eclampsia is usually defined on the basis of new onset hypertension and albuminuria developing after 20 weeks of pregnancy. Our patient does not classically satisfy the criteria for the diagnosis of pre-eclampsia, but since this is the first diagnosis of hypertension in her and her clinical course did not allow for full evaluation, she might actually have been pre-eclamptic since women with no proteinuria. But who do have hypertension and other features such as severe headaches, thrombocytopenia, hyperuricaemia, disordered liver function and fetal compromise are likely to have pre-eclampsia.

The placenta is the key factor in inducing pre-eclampsia and its expulsion during delivery or caesarian section is the definite cure of the process. In our patient, the delay in referral and the fact that she had severe pulmonary oedema made it impossible to contemplate caesarian section because both general and epidural anesthesia have risks of severe side effects in such circumstances. Our patient was placed on hydralazine in addition to the treatment for pulmonary oedema. She however did not do well and died 12 hours after admission. The reason for the loss of this patient and the fetus are clearly linked to the delayed referral since the clinical, biochemical and haematologic manifestations of pre-eclampsia are very typical facilitating early and easy diagnosis.

Congestive cardiac failure and other cardiovascular conditions such as severe cardiac dysfunction, pulmonary hypertension. Marfan's syndrome, severe obstructive lesions of the left side of the heart etc all place the mother and the fetus at extremely high risks. Women with such conditions should be encouraged to avoid pregnancy and the interruption of pregnancy (in those already pregnant) may be advisable in cases with great risk of disability or death. Early referral in this case of this patient would have allowed proper evaluation and appropriate counseling of the patient.

Hypertensive heart failure is rare during labour largely due to advancement made in both hypertension and heart failure management. The practice of ante-natal care also picks out and properly manages all at risk pregnant women. Acute congestive cardiac failure had been reported in a hypertensive women receiving salbutamol for premature labours.

Mortality from such cases can be reduced significantly if all cases of hypertensive disorders in pregnancy are referred early to a specialist centre which has full complements of specialty practices required by such pregnant women.

ii. **Takotsubo cardiomyopathy**

Mr. Vice Chancellor Sir, esteemed guests, permit me to briefly talk about a kind of heart disease that had been with us, but got little attention. Tako-tsubo is a Japanese term meaning octopus trap. This is a special trap that looks like a pot that is oblong(Figure 3). It is use to trap octopus, because octopus only goes forward it does not move backward, so after entering, the octopus is trapped inside. The shape of the trap is similar to the appearance of the left ventricle which balloons at the apex in patients with the form of cardiomyopathy.
It was first described in Japan in 1991.



Figure 3- Octopus trap
This cardiomyopathy is also called by other term like:-

1. Stress-induced cardiomyopathy
2. Transient left ventricular ballooning syndrome
3. Apical ballooning syndrome and
4. Broken heart syndrome

Takotsubo cardiomyopathy is characterized by transient apical and mid- left ventricular dysfunction in the absence of significant coronary artery disease that is triggered by emotional or physical stress. Typically normal left ventricular function recovers with 1-4 weeks.

This type of heart disease had been confused with acute coronary syndrome (heart attack) even in developed countries. It may lead to death in up to 8 out of 100 persons affected. It is much more common in women (up to 90%) and more than 80% of cases are postmenopausal women.

Typically the disease is triggered by some events:-

- Death of a loved one
- Devastating financial loses
- Natural disasters
- Physical illness and/or
- Other catastrophic news

This, Mr. Vice Chancellor Sir, brings me to the long held belief among the Hausa community that one can "hadiye zuciya" and die. Truly if the above triggers are interpreted into our setting, then the phenomenon of sudden death from tragic news, an unpleasant happening or certain circumstances that are not socially, culturally and morally acceptable could well be appropriately classed as tako-tsubo cardiomyopathy. We have not been able to describe it adequately and report to the world because we lack the necessary tools to make adequate diagnosis. Echocardiography which is the main stay of diagnosis of this condition became widely available within the last 10 years in Nigeria.

Mr. Vice Chancellor Sir, even with the advancement of the west, takotsubo cardiomyopathy was not described there. It took power of observation and abstraction of the Japanese to describe the syndrome in1991. This underscores the power of being very observant and creative in the art of medicine.

I can recall, just like most health care professionals in Nigeria and indeed the general public would recall, a case or cases, that if subjected to evaluation would fit into this syndrome in our practice.

The postulated reason for this syndrome includes release of excess hormones of fight and flight by the affected persons, among other hypotheses.

Patients who are suspected to have this type of disease must be managed optimally and urgently. They must be supported and as much as possible the stress should be removed (in this light, I am sure the social scientist will agree with me that the reason why we do not have a lot of this is because of the nature of our family life which provides a lot of support as at when due).

Overall, the outcome is good if the patients survive the acute phase and long term prognosis is excellent.

HIV/AIDS and the Heart

Mr. Vice chancellor sir, permit me to talk about a topic that is difficult to ignore in the medical practice of today. Over the last three (3) decades, HIV/AIDS had modified the practice of medicine in virtually every specialty.

HIV stands for "Human Immunodeficiency virus" and AIDS stand for "Acquired Immunodeficiency Syndrome". Basically what this Virus does, is to destroy the central command in the body defenses with consequent affectation of the body by ordinary and opportunistic disease. Ordinary diseases such as Malaria, Pneumonia, Typhoid e.t.c. Opportunistic diseases such as candidiasis and opportunistic malignancies. The heart and cardiovascular system being part of the body is also affected by HIV/AIDS disease.

In the wake of the epidemic in Nigeria, with the high prevalence and the limited access to antiretroviral therapy, the dominant forms of HIV associated heart diseases were pericardial tuberculosis, cardiomyopathy and pulmonary hypertension. The fight against the HIV/AIDS epidemic in Nigeria and Africa was aided by support from the international community, notably the USA presidential fund for HIV/AIDS (PEPFAR). Now patient with HIV/AIDS are living longer with highly active antiretroviral therapy (HAART), so much so that HIV/AIDS has now become a part of the chronic disease burden just like hypertension and diabetes. HIV/AIDS related cardiac disease represent a diagnostic and therapeutic challenge in clinical practice; cardiologist are more frequently encountering this problem. An intimate knowledge of

opportunistic infections affecting the heart, effects of long term HAART therapy and effects of therapy for opportunistic infections on the heart is needed to be able to formulate a differential diagnosis. Effects of HAART therapy, especially protease inhibitors on lipid and glucose metabolism and their influence on progression to premature vascular disease require considerations. Treatment of cardiac disease in HIV/AIDS patients can vary from non-HIV patients, based on drug interactions, differences in responsiveness, and other factors.

Mr. Vice Chancellor Sir, esteemed guest, the problems posed by HIV/AIDS to physicians is further compounded by our cultural beliefs, social practices and family values and interactions. A lot of people till today do not believe in HIV/AIDS, this at a point included our learned religious leaders, traditional rulers and even some members of the academic community. This lead to a galore of deception of people afflicted with HIV/AIDS in the belief that they can get a "cure". The attitude of people including health care workers towards People living with HIV and AIDS (PLHA) complicated the experiences of PLHA in Nigeria and most of Africa.

Mr Vice Chancellor Sir, ladies and gentlemen, permit me to share a summary of our research findings on the Sexual and family planning practices and needs of PLWA in Nigeria. This study was supported by a travel fellowship to the University of Witswatersrand in South Africa, where I was trained in research methods and Sexual and reproductive health. The grant was secured by dRPC Kano from the Institute for international education, San Francisco, USA.

Sexual and Family Planning Practices and needs for PLWHAs in Nigeria – a rapid ethnographic assessment

Introduction

Ethnography is a Greek word :- ethnos-nation/race and graphe- writing

It is the study of a small group of people describing what they do , how they do it and why they do it. PLWHA stands for people living with HIV/AIDS one third of the world's population is between 10-24yrs

Four fifth(80%) young people live in developing countries, this is expected to reach 87% by the year 2020.

In most countries most young people are sexually experienced by age 20 years. Pre-marital sex has been shown to be common among the 15-19 year olds. Pre-marital sex happens in 73% of young men and 28% of young women in *Rio de Janeiro;* 59% and 12% respectively *in Quito* and *31% &47%* respectively *in Ghana* –Population Council, 1996

Design/Setting

- Qualitative approach
- Focus Group Discussion and Group interviews
- Selective in depth interviews
- Over a period of three weeks
- Two associations of PLWHAs namely *Living with Hope* and *aids alliance Nigeria* were interviewed
- Officials and members were interviewed

Findings- *PLWHAs*

- Most are worried about life
- Unhappy about circumstances of their diagnosis
- Loose confidence after learning of status
- Most loose hope on life
- Most are not empowered
- Worried about fellow PLWHAs sacked from their jobs based on serostatus
- They would like to have children… but
- How are they going to look after them?.. some asked
- Men's attitude to their wives is worrying especially if the woman's status is known first
- Some send the wives away and refuse to get tested themselves
- PLWHAs believe that poverty and polygamy are the main reasons for the continued spread of HIV
- Literacy levels and socio economic status influence perception and ability to cope with being HIV positive
- Low education level is associated with misconception about HIV and loosing hope on life.

- Low socioeconomic status determines to a large extent the *health seeking pattern, increased frequency of infections* and *hopelessness* of PLWHAs
- Most PLWHAs are exploited by other people and "healthcare workers"– *orthodox or otherwise*
- Most PLWHAs want to have children.. *to be remembered!!!*
- No specific sexual or reproductive health program for PLWHAs
- Most are not well informed about safe sex practices and planned pregnancy
- The females are unable to decide on sex... is the exclusive reserve of the man!!!
- Most PLWHAs especially of low education and socioeconomic status believe that pregnancy cannot be planned.
- They believe that unwanted pregnancy can always be aborted
- None of them could explain what is safe or unsafe abortion
- Little knowledge of STIs and HIV/AIDS information
- Most are not aware of family planning methods, few know about male condoms
- Few (less than 10) know or heard of the female condom
- Fears and misconception about condoms e.g may get missing inside the woman
- Female condom is not popular due to high cost, unavailability and the few who know it don't know how to use it
- Levels of education plays a significant part in the KAP of condoms
- Very few PLWHAs are familiar with other family planning methods such as the pill, loop and the injectable
- There is a strong believe about the natural ways of birth control... *cultural and religious influences*
- Worried about the distribution modality, availability and accessibility of ARV in the country

PLWHA associations.

Living with hope and *aids alliance Nigeria*

- Membership around 300 and more than one thousand respectively
- Regular meeting and programs
- Education on HIV/AIDs and healthy lifestyles for members
- Vocational training for members though limited by finances
- Psychological support for members
- Home based care for members who are down
- HBC is expensive and the associations have difficulties
- Members are being exploited by those in ARV distribution system
- Most members cannot access the FG ARV drugs
- Members maltreated in clinics
- No enabling law to strengthen their course
- Need for an enabling law to help PLWHAs fight for their rights
- Need for enabling law to protect them from exploitation by 'medical staff' such as inexperienced practitioners who administer wrong treatments to them
- Members complain that NGOs and government agencies use them to showcase HIV/AIDS problem without any benefit for the members
- Feels that there is no genuine effort by any agency in their interest

Identified patterns

- State of despondency and hopelessness
- Mostly PLWHA are not empowered
- Knowledge and perception of male condom is very poor
- Education and socioeconomic class determine attitude and believes of the PLWHA
- Poor KAP on sexual issues e.g safe sex, condom use, STIs, and safe abortion
- Most PLWHA's expres the desire to have children
- Deep seated negative belief about condom

- Hopelessness leads to PLWHAs resignation to their fate, not willing to take on jobs, and thus unable to take care of themselves.

From our findings, we suggested ways forward that may help solve some of these concerns.

Suggested Programmes

Empowerment Programmes:-

- To change views of PLWHA's, about life
- Being HIV positive is not the end of life
- Their despondent attitude and hopelessness should be addressed.

Condom awareness and promotion:-

- For both males and females
- Consistency of condom use is very difficult to achieve.
- Programs should examine ways of increasing use and consistency of condom
- Behaviour Change Communication (BCC) should be used to encourage safe sex practices.

Awareness(recognition), prevention and management of STIs

- Peer education
- Condom awareness and promotion
- Presumptive treatment of STIs with antibiotics.

Prevention of mother to child transmission(PMTCT)

- Exploring different ways to involve men more actively in the counseling and care of pregnant women.
- Testing strategies for mobilizing communities to support Mother to Child Transmission (MTCT) programmes.
- Program for counselor training strategies.
- Programmes

Integrating Family Planning and HIV/AIDS programmes.

- Reduce the stigma about people going to receive care,
- A clinic that is strictly for PLWHA or for HIV/AIDS care is likely to be shunned.
- Integrating the services with other fairly acceptable service will increase the chances of acceptance and patronage.

Conclusion

The challenges of being a doctor in a developing world is enormous, this is largely due to the gap between the level of practice in his part of the world and the literature by which he is to be guided. This is further compounded by the dearth of practitioners who are "called" to practice the art of medicine(calling here meaning the inherent commitment to the art of medical practice). Thus, it is common place to see a health care worker struggling to find textbook description of condition that is not validated for his region of practice.

A typical example in my specialty is the case of a patient who had an electrocardiogram (ECG) done and the machine (made in Europe/USA) diagnosed acute coronary heart disease/myocardial infarction. The health care worker informs the patient that he has heart attack, when his heart is perfectly working. The patient is left confused and devastated, knowing fully well that a 'heart attack' in our environment equates death. This underscores the eternal relevance of the human components in healthcare delivery. A Physician with the right knowledge and skills will at least be 80% correct in diagnosis without depending on results of diagnostic gadgets.

The doctor is again, in an environment that hardly regulates medical practice (both modern and traditional). Therefore the doctor must be prepared to deal with complicated cases and cases that are improperly managed. He should be ready to deal with the side effects of both modern and traditional medicines. This is the reality of today in our health care system.

The patient is faced with the big issue of desiring "state of the art" health care at least for those who can afford. This opens the door for exploitation in the name of medical tourism. Nigerians had spent much more that is required to revamp our health sector, in the name of going for treatment in other countries. The results of such escapades are mixed with some successes but at the same time most people would travel, spend the money and still have to come home with the same condition or worse off.

Mr Vice Chancellor Sir, you may have noticed that, the works I presented today were carefully selected based on the qualitative nature of the research work carried out, because it is my belief that a doctor needs to understand the social, economic,

cultural and religious environments of his patients, in order to make a success of medical practice. It is my opinion, that research works in our practices MUST have a qualitative outlook because as the social scientist would say, 'man is a social animal' with behaviors and practices that need to be understood well, especially in the practice of Medicine.

Mr Vice Chancellor sir, distinguished listeners, the practice of medicine and especially cardiology in our country will not have completed its mission until its main spirit and outlook permeate every practitioner of it:

- That medicine is a humane art, enriched by years of sacrifices and that it deals kindly with all,
- That it is a wise art that addresses the whole dimension of life and living experience and
- Finally, that character counts far more than other virtues among its practitioners.

Thank you for your attention.

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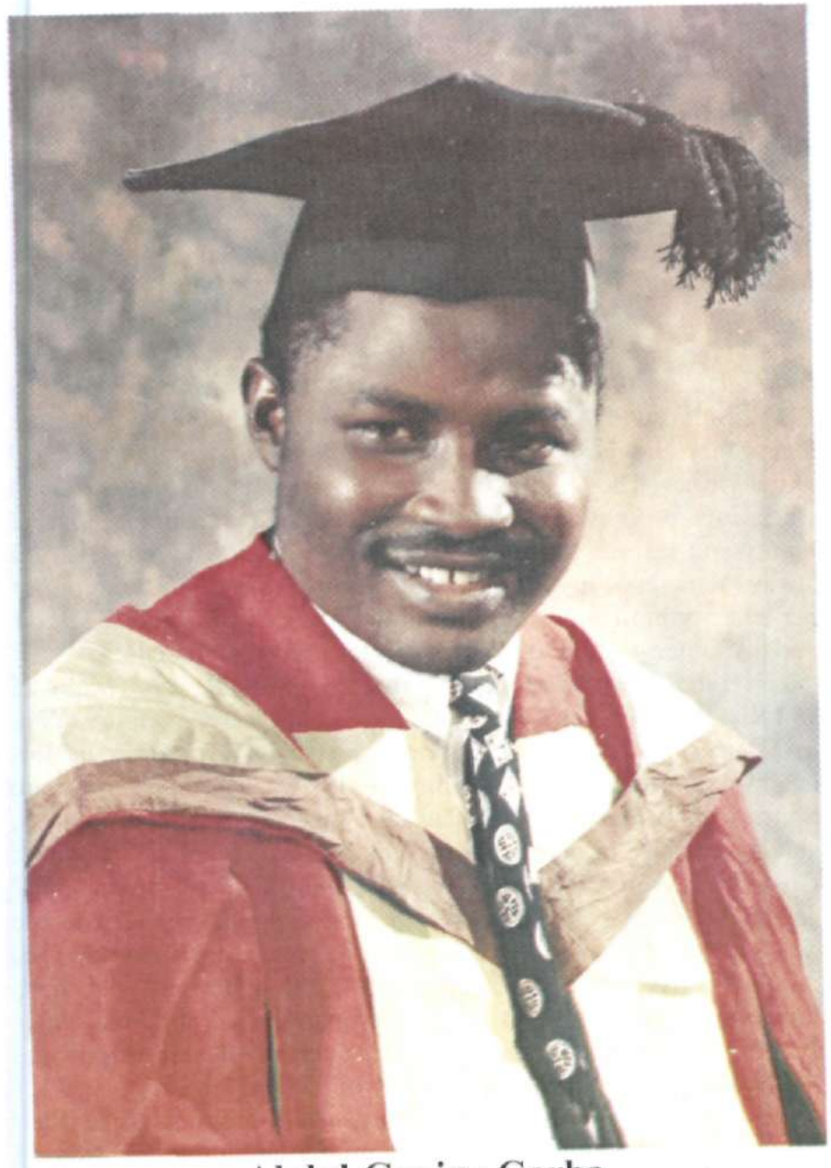
Chapter Two

Economics: A Discipline in Need of a New Foundation

Economics: A Discipline In Need of a New Foundation

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(Professor Sam Olofin and Mr. Danladi Kifasi) and the external members (Mr. John Oshilaja; Dr Shehu Yahaya; Professor Doyin Salami and Professor Chibuike Uche).

The Nigerian Economic Society (NES) has offered me several opportunities to serve, and to grow in service as Assistant Editor, Secretary and Editor of the Nigerian Journal of Economic and Social Studies (NJESS). My gratitude to the NES is unquantifiable. I am equally indebted to the African Economic Research Consortium (AERC) who provided funding support for my research in 1991-97, 2002 and 2006. In addition, the AERC facilitated my appointment as visiting scholar to the IMF in 1995 and 1997. The appointments were pivotal in my intellectual growth.

Mama Seun, Tunde, Biodun, Kabiru, Yakubu, Mallam Isiaku, Apalowo, Ezekiel, Damilola and Oyindamola, you brought into our lives much value in your services and have become part of our family. God Almighty will bless and reward you abundantly.

Dr. Floretta Akinghade our dearest friend, as usual offered her valuable time to edit and considerably improve the quality of this lecture. Kassey and I greatly appreciate her friendship and her love for us. May God reward her and bless her family richly. I also acknowledge with gratitude the valuable contributions of Mr Emmanuel Apalowo who patiently typeset the lecture.

Next to salvation and godliness is a blissful marriage. God has blessed me with the flesh of my flesh and the bone of my bones and united us as one. The mathematics of marriage is not addition but union (set theory). For it is in the union of two sets united by divine love and friendship and compacted by faith and hope that two become truly one. I am most grateful to God for the wife He gave me. My baby is beautiful inside and outside and both have attracted and locked-me into blissful contentment that I did not imagine possible. God who brought us together and has kept us together and lifted us to heights we never imagined possible deserves our eternal praise and worship. My prayer my love, is that we shall live in His light all the days of our lives. My baby, Kassey Garba, I love you in increasing measure and by His grace, we will be together forever. God bless you and make you fruitful in His vineyard all the days of our lives. Amen.

Mr. Vice-Chancellor, Deputy Vice-Chancellor (Administration), Deputy Vice-Chancellor (Academic), Dean of the Faculty of Social Sciences, Dean of the Postgraduate School, Deans of other Faculties and Directors, Head of Department of Economics, Heads of other Departments, Colleagues, Students, Gentlemen of the Press, Distinguished Ladies and Gentlemen, I thank you for your patience and kind attention.

Preamble

It is with gratitude to God Almighty and with humility that I stand before you, representing the Faculty of the Social Sciences, to present the first inaugural lecture on behalf of the Faculty. I thank the Dean of the Faculty for his graciousness and for encouraging me to give the 2013 Inaugural Lecture. I also thank my colleagues in the Faculty and, the Head and staff of the Department of Economics for their support and prayers.

Mr. Vice Chancellor Sir, I thank the Ahmadu Bello University for giving me this platform today to share my work in the field of economics as well as my deepest thoughts about the future of economics with academic colleagues, students and the general public. I deeply appreciate your presence and that of everyone here. My prayer is that the value of this lecture will reward your time and patient attention.

In thinking through several topics for this inaugural lecture, I sought a topic that would enable me reflect about my work in the field of economics but even more fundamentally, to appraise the state of economics as a field of study from its foundations. My primary goal in doing so is to contribute to the continuing debate about the future of economics and implicitly, the future of humanity. In thinking through and in writing, I sought divine grace for knowledge, for wisdom and for understanding, for I know that I have no knowledge, wisdom or understanding of my own. I also sought grace for boldness to write as truthfully as I can.

The topic "Economics: A Discipline in Need of a New Foundation" raises at least six fundamental questions that have troubled me at various stages of my career as a student, teacher and researcher of economics; and also as a policy maker. First, how much does economics describe, explain and predict and how successful has it been in describing, explaining and predicting? Second, should economics explain and predict as the natural sciences do, or should economics solve concrete puzzles and problems? Third, should the foundations of economics, be limited by the desire of economists to be scientists; or by the need for solving concrete puzzles and problems? Four, how sound is the foundation of economics for solving puzzles and problems? Five,

how can economics better serve society, and what type of foundation does it *need*? Six, do economists *want* a new foundation for economics? The six questions are the focus of this lecture.

Before I address these questions, I provide some background on how I became an economist and how my practice of economics has evolved to this point. The background provides foundation for the Lecture and it is on the foundation that I shall anchor my reflections on the six fundamental questions. I have read Mark Blaug's *100 Great Economists before Keynes* (Blaug, 1986) and I found that the experiences of the economists influenced both their learning and their "doing economics". For example John Stuart Mills was significantly influenced by his father James Mills who taught him Greek at 3, Latin at 8 and political economy at 10. Because James had the support of his friend Jeremy Bentham in tutoring his son, John became influenced by Bentham's philosophy until John's experiences in the East India Company led him to doubt Bentham and to shift towards a synthesis of British and French traditions (Blaug, 1986). In deviating from Bentham's general happiness *principles*, he helped to build the foundations of orthodox economics by delineating its domain and methods that survive till today. It is also generally acknowledged that Harriet Taylor (whom he befriended and married after "waiting for about 21 years") influenced John's work particularly, *The Subjection of Women* in 1861. I also wish to acknowledge that my experiences have had profound influences on my learning and doing economics.

The Foundation

An Economist by Fate

I encountered economics in 1976 in my third year of secondary school. My first impression was influenced by the passionate and lively way in which my teacher (Mr. Jacques) taught economics and the way he grounded it in everyday reality. My teacher in the fourth year (Mr. Ogunsanya) had an interesting *call-and-response* method of teaching economics that excited us students. For instance, in explaining the behaviour of wages to changes in global demand, he would first lay a foundation of how an increase in global demand could *cause* prices of goods to rise, and

how a rise in prices of goods could *cause* increases in wages. The call and response session would go thus:

Mr. Ogunsanya:	Higher what?
Students:	Higher wages.
Mr. Ogunsanya:	In the world what?
Students:	In the world market.

Through the call and response strategy, Mr. Ogunsanya impressed on our consciousness basic economic relations and analysis. In our exuberance however, we nicknamed him "Higher what?" Then and now upon reflection, I find that my early encounter of economics was filled with liveliness.

At the A-Levels, economics for me lost its liveliness and became increasingly abstract. It lacked for me the appeal of science (realism, observation, experimentation). In place of the appeal of science, A-Level economics had this annoying practice of depending on the catch all cliché "other things being equal" when it was clear to me and most of my colleagues that nothing was ever equal. The absence of liveliness of economics at the A-Levels was not the fault of my teachers for in Mr. Epson Gapsiso we were blessed with a teacher that was passionate, committed and effective, to the extent that when he had to leave for higher studies in the Department of Economics at Ahmadu Bello University, most of us wished that he would stay. Believe me, he gave us the very best. The problem was economics itself; particularly, its peculiar way of analysis which I later came to understand was the commitment by the leading 19th and 20th century economists to positivism as the favoured ontological approach. John Stuart Mills argued that the best way to build an economic science was through "thinking from hypothesis" (Mills, 1994). However, with *claims about reality* being the essence of positivism, it was inevitable that economic theory and economic reality will differ. Moreover, the theory-reality divide was not only inevitable, but the gap between theory and reality was likely to grow overtime as the incentive system rewards abstract theorizing far

more than empirical, applied or concrete problem solving economics.[1]

By the end of my A-Levels, I had lost interest in economics as a field of study to pursue further. To express my dislike of economics, I gave out my economics text books for I had no desire to read economics in the university. Yet, it was economics that I studied in the university. And it was in economics that I excelled, graduating in 1984 as the best student in the department and the faculty with First Class Honours. My reading economics and the gift of performance that I was blessed with was in spite of my *wants* and *desires*. It was simply fate. It was what I was created to do.

I have had the privilege of interviewing two of my teachers and mentors Professors Sam Olofin and Professor Mike Kwanashie who were chair of my PhD and MSc Thesis Committees respectively.[2] One of the first questions I asked them was: how did you come to study economics? Both had the same answer. Fate! Their stories were different but the driving force was the same; fate.

Once I was registered to read economics in this great university founded on a sound vision and sound principles, I gradually adjusted to my reality. My teachers were very helpful in the adjustment process. Professor Bhambri inspired me by the way he taught microeconomics with confidence and simplicity. He would come to class with only his chalk and duster and take us through a journey that left me richer every time. Then there was Agogo Mawuli who taught Introduction to Mathematics for Economics and S.N.A. Mensah who taught me Mathematical Economics (Part II and Part III) and Project Evaluation (Part III). Both of them taught with great commitment that was stimulating and added considerable value to my acquisition of intellectual skills. Ode Ojowu had an interesting way of teaching that challenged me to see beyond the obvious; to interrogate the philosophical basis of economics. Soft spoken but his words soft and few as they were, were pregnant with meaning that challenged me.

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[1] The Nobel Prize in Economic Science has recognized mainly econometrics and theoretical work in the orthodox traditions. As at 2012, of the 71 individuals honoured, 26 were affiliated to University of Chicago (Wikepedia, 2013).

[2] Garba (2006) documents the interview with Professor Olofin.

Dr. James Attah kindly accepted me in his Econometrics class in part III (the final year of undergraduate study). I was supposed to have taken classes in Theory of Statistics in part II if I planned to take econometrics. I was not aware of that and registered instead for Elements of Statistics which was required for Applied Statistics. I chose to register for Econometrics to avoid writing a project. Dr Attah counseled me that it would be challenging to take Econometrics without having taken Theory of Statistics. He registered me after I assured him that I would make up, on my own, the deficiencies; having considered that I had taken Mathematical Economics in part II and was also taking it in part III. I am grateful that he registered me. He gave me and my course mates a solid foundation in econometrics both by the content of the course and the way he taught it. He gave econometrics life with his style of *doing econometrics by logical narratives*. Often, we encountered at appropriate junctures recall x and given y then, z. The stories between x and y and z made x, y, z to be not mere abstract symbols but *symbols of meaning and of meaningful relations*. When I later got to teach econometrics, I tried to teach using his style.

Professor Mack-Jones an African-American came to the Department of Economics in 1983 and taught microeconomics in a way that was remarkable giving great emphasis to developing our analytical abilities. After one of our tests, she sent for me. When I saw her she reviewed my answers pointing out that my analytical skills were good and discussed with me on how to improve on it. Her actions greatly encouraged me.

During the undergraduate years, my concerns about economics receded to my sub-conscious. I found the electives (mathematical economics and econometrics) and, microeconomics (which was also mathematical) the most exciting. Being in the midst of friends that read political science (Chris), archaeology (Lawrence), history (Joshua), sociology (Nathan) and geography (Solomon) and the intense debates we had filled for me what economics lacked: realism, diversity of perspectives and arguments. I also learnt greatly from the vibrancy of the critical intellectual culture in the then Faculty of Arts and Social Sciences (FASS). The seminars, conferences and workshops that were frequently organized saw so much intellectual fireworks that helped students to have a critical and broad intellectual horizon. Between the time I

organized saw so much intellectual fireworks that helped students to have a critical and broad intellectual horizon. Between the time I graduated and the time I returned as a graduate assistant, much had changed.[3] Also, between undergraduate and post-graduate school, much had also changed.

The environment of graduate school lacked the vibrancy of the undergraduate environment. For one, the boundaries that disciplines set for themselves; seem more rigid in graduate school than in the undergraduate programmes. Because of this narrowness, my skepticism about economics returned more forcefully. By the time I went for the PhD programme in Ibadan, which was famed for its strong commitment to orthodox theory, my skepticism expanded to questioning the role of mathematics in economics, the practice of econometrics, the impotence of econometrics in resolving economic disputations and the weaknesses of the core concepts of economics. My skepticism was deepened by my introduction to the History of Economics Literature by a senior colleague in the department (Mr. D. D. Bolaji) who introduced me to books such as *Knowledge and Ignorance* by Terence W. Hutchison a famed empiricist and critique of orthodox economics.

Indeed, my skepticism delayed my choice of a problem for my PhD thesis. Eventually I had to give in to conducting an applied econometrics study of external shocks and policy responses despite my initial reservations. To motivate myself, I reasoned with myself that once I had successfully completed the thesis and graduated, I will be free from the burden of supervised study. Then I will be free to think, research and write my convictions. So doing an econometrics oriented study was to me a price I had to pay to be free to think, write and publish as my research and reflection led me. In March 1994, I won my freedom.

Under the guidance of my supervisor (Professor Sam Olofin) I developed, estimated and simulated a small open economy econometric model of the Nigerian economy which I then used to measure and decompose the effects of external shocks and policy responses on selected macroeconomic aggregates of the Nigerian

[3] The FASS was losing its vibrancy with the exit of leading scholars and the sapping of the intellectual environment as structural adjustment policies began taking their toll on real income, living standards and learning environment.

the Nigerian policy process and its links to external shocks and macroeconomic variables. Second, it employed econometric methods in a more rigorous way to achieve the objectives of the research. Third, it added value in terms of a much richer analysis of policy using the methods of simulation experiments. The improvements also improved the main conclusion of the M.Sc. Thesis.

In my M.Sc. thesis, under the guidance of my supervisor (Professor Mike Kwanashie) I reflected on the effectiveness of fiscal and monetary policy to generate sustained economic growth in Nigeria (Garba, 1988). The primary concerns were that (1) the fiscal anchor oil revenue was volatile hence (2) all key policy instruments fiscal, monetary and trade exhibit similar patterns of volatility. Consequently, the monetary and fiscal as designed and implemented lack the capacity to generate and sustain economic growth. The implications of the econometric results which supported the thesis were that Nigeria needed to (1) significantly minimize the dependence on oil revenue and (2) alter the structure of investments to build sound infrastructure if growth was to be self-sustaining.

The main conclusion of the PhD thesis was that generalizations about the impact of government policies or external shocks are misleading because the impact of policy and external shock were non-uniform across macroeconomic variables. Therefore, the effectiveness of government policies did not depend on generalizations, but on a careful analysis of policies given due attention to the policy environment. The recommendations were:

> that the framework for Nigerian government policy should have at least two attributes. First, it is broad enough to deal with the multiple direct and feedback effects of government policies. Second, it should have the capacity to deal explicitly with the problems which structural and policy dependence poses to a small open mixed economy. Finally, the study recommends that government policies must aim at reducing the degree, extent and character of policy and structural dependence to reduce the dis-stabilizing impacts of external shocks on the Nigerian economy. (Garba, 1994)

Learning and Doing Economics

Learning Economics

I started teaching economics at a secondary school (during the National Youth Service Corp programme from 1984-85). I taught briefly at A' Level institutions (1985-86) before joining the Ahmadu Bello University in 1986 as a Graduate Assistant. My post-graduate training began in January 1987 shortly after joining the University. As a Graduate Assistant, I enrolled in the MSc. programme in 1987 graduating in 1988 after which I proceeded to Ibadan in October of the same year for the PhD programme; I graduated in March 1994. My postgraduate training was unique because of the contrasting traditions in Zaria and Ibadan. The postgraduate training in Zaria was rooted in the critical intellectual traditions of FASS while the Ibadan programme had deep and extensive roots in the orthodox traditions of economics.[4] From Zaria I imbibed the critical tradition and from Ibadan I imbibed a deeper appreciation of orthodox economics. The critical tradition encouraged me to seek (1) alternative perspectives of economics; (2) make up for my deficiencies in History of Economics and (3) develop an interest in the philosophy of economics. The orthodox tradition in Ibadan encouraged me to seek a deeper understanding of the organic structure of orthodox economics as necessary for any meaningful critical work. The two contrasting influences from Zaria and Ibadan shaped my learning as well as my doing economics.

Although I took to Ibadan a skeptical attitude to orthodox theory, I nevertheless sought to understand it clearly and deeply; indeed, one of my goals in Ibadan was to deepen my understanding of orthodox economics. The diverse set of topics in the core of economics (microeconomics and macroeconomics) and the applications of the core (development economics, international trade, public finance, monetary economics and so on) posed a challenge to me. I sought a simple analytical framework that would

[4] Although Professor Bade Onimode in his microeconomic theory class and in his research and publications was critical of orthodox theory, he taught the course in the best orthodox tradition. Similarly, Professor Sam Olofin espoused utilitarian views, yet he taught macroeconomics in the best orthodox traditions (Garba, 2005).

help me navigate through economics clearly and simply. At the time in the late 1980s, the crisis in macroeconomics was still current and one of our compulsory readings in Prof Olofin's macroeconomics class was *Crisis in Economic Theory* edited by David Bell and Irving Kristol (Bell & Kristol, 1981). It had contributions from leading economists: Kenneth J. Arrow, Daniel Bell, Paul Davidson, Peter F. Drucker, Edward J. Nell, Harvey Leibenstein, James W. Dean, Israel M. Kirzner, Allan H. Meltzer, Irving Kristols, Mark H. Willes and Frank Hahn. The general concern was a failure of theory to provide credible or reliable guide for economic policy. The main criticism against Keynesian economics was the rational expectation critique that Keynesian economics lacked micro-foundations and that its policy recommendations were as a result, flawed. It occurred to me then that if the crisis in macroeconomics was that it lacked micro-foundations or to be more specific that it was not consistent with neoclassical economics, then microeconomics was foundational to macroeconomics. Therefore, understanding the structure of economics required a basic understanding of microeconomics.

After careful reflections, I developed a flow chart to help my understanding of microeconomics. I have provided in Figure 1 below a simplified version, which nevertheless shows the core elements and relations of orthodox economics. At the base of the chart were the related concepts of scarcity and choice. And on the base are built *three hierarchies of theory*: theory of economic actors (consumer theory and producer theory); theory of economic markets (partial equilibrium and general equilibrium theories) and theory of welfare. The first two make up positive economics and the latter, normative economics.

At this point in my learning economics, I did not interrogate the concepts of scarcity and choice or, the concept of economic man or *homo economicus*. I simply accepted that scarcity and choice were the foundations of orthodox economics and that it was on them that positive and normative economics were built. Also, that in the three hierarchies of theories, equilibrium analysis was the norm.

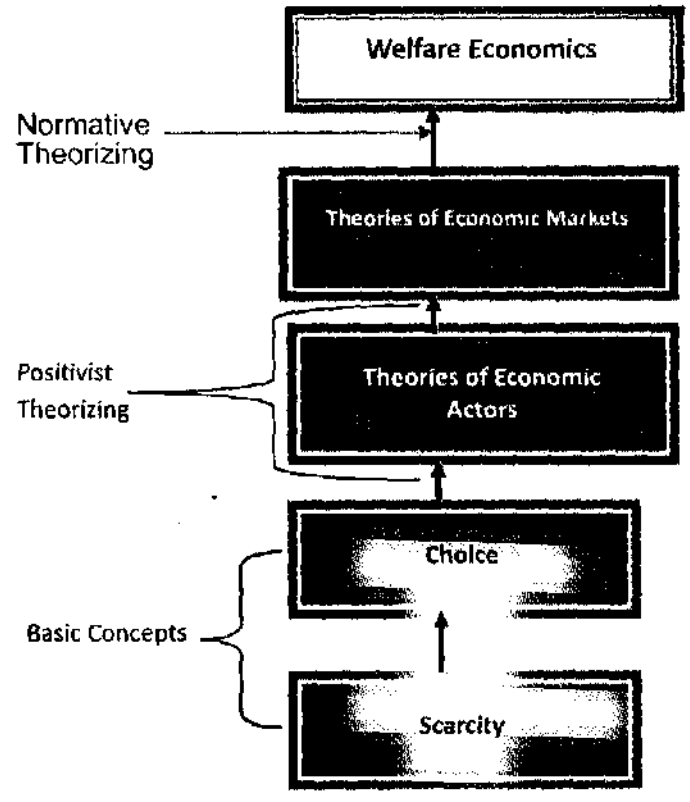


Figure 1: *Basic Insight into Orthodox Economics*

The theories of economic actors institutionalized *goal equilibrium analysis* by formalizing and analyzing constrained optimization models of utility maximizing consumers and, constrained optimization models of profit maximizing producers. The theories of economic markets institutionalized *partial equilibrium* (equilibrium analysis of an isolated market) and *general equilibrium* (analysis of interdependent markets in competitive equilibrium). The less scientific or "normative" part of economics addresses analysis of alternative states of the economies (alternative competitive equilibriums) in terms of their welfare implications. Welfare economics is built on the positive structure and like the positive structure; it is the product of deductive reasoning. Its "normativeness" quality is given by the values that are explicit in the evaluation of alternative states of the competitive equilibrium.

The analytical framework sketched in Figure 1 implies that: (1) the truth of the market model depends on the truth of choice theory and the correctness of the logical structure linking choice theory to market model and (2) the truth of choice theory depends on the validity of the conceptual foundations and the correctness of the logical reasoning linking conceptual foundation to choice theory. Therefore, the validity of market model depends on the validity of the conceptual foundations, the correctness of the logical reasoning linking conceptual foundation to choice theory and the correctness of the logical reasoning linking choice theory to the market model.

The framework led me to recognize the importance of concepts in economic theorizing and in evaluations of economic theories. As a result, I had strong incentives to develop further an interest in the history of economic thought that was kindled in Zaria by Mr. Bolaji through his friendship which allowed me to listen in on his nostalgic discussions with Mr. Z. T. Abdallah on history of economic thought that they were taught. The intellectual engagements encouraged me to read books on history of economic thought and in the process to discover books on philosophy and methodology of economics.[5]

Figure 1 also embodies three essential features of the theorizing principles of orthodox economics. The first is the preferred ontological approach (positivism) that gives primacy to the making of claims about economic phenomena.[6] The second feature is the method of analyzing aggregate behaviour through analysis of atomistic behaviour. In both consumer theory and producer theory which are the flagships of orthodox theory, the method involves (1) a formalization and analysis of the choice problem of the atomistic agent (as consumer or producer) and (2) the employment of principles of additivity to transit from individual to market analysis. The third attribute influenced by physics, is the choice of

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[5]Two of the books that I was very interested in were T. W. Hutchison's *Knowledge and Ignorance in Economics* (Hutchison, 1977)and Janos Kornai's *Anti-Equilibrium* (Kornai, 1971)

[6] It is this ontological approach that empowers economists to invent abstract particulars such as homo economicus and perfect market and to use them as analytical pillars even when it was known that they do not exist. These abstract particulars are them employed to make claims about real economic actors, real markets and real economies.

equilibrium as the end point of analysis. Thus, at the first level of analysis that is the atomistic level, the focus is *goal equilibrium* while at the second level, the focus is *market equilibrium*. The fourth feature is implicit in choice theory: the idea that atomistic agents seek the most preferred option or the best available option. All four essential features of orthodox economics are still subject of much disagreement in economics as they were in my graduate days.

My concern was not limited to the potential weaknesses of orthodox economics. I was concerned also with the attempts to unify microeconomics and macroeconomics. I was convinced that the methodological commitment and the social philosophy of Keynes's *General Theory of Employment, Money and Interest* differed sufficiently from those of orthodox economics to make a synthesis difficult to achieve. Whereas orthodoxy was deeply wedded to positivism, Keynes believed that "economics was a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world." He also believed that economics was unlike the natural sciences because economic phenomena and agents were not homogeneous. Thus, the successful economist must have a gift for using "vigilant observation" to choose good models. Keynes did employ the art of "vigilant observation" to formulate premises he used to develop his general theory deductively. A second area of difference was that the orthodox economists and Keynes were committed to different social philosophy. Contrary to orthodox positions, Keynes supported more equity in income distribution and, the euthanasia of the rentier capitalist through socialization of capital.

The IS-LM "synthesis" which evolved out of the paper by J. R. Hicks (Hicks, 1937) was not designed to be a synthesis of microeconomics and macroeconomics. In the paper Hicks made it clear that his purpose was to develop a typical "classical model" in a form similar to Mr. Keynes' to use in a comparative analysis that would reveal Keynes' innovations and help the discovery of the real issues in dispute. Hicks admitted that the model he developed was "a skeleton apparatus . . . a terribly rough and ready sort of affair" (Hicks, 1937). Yet, the "skeleton apparatus" became the standard pedagogy for macroeconomic teaching for almost half a century. The framework was employed in teaching about the workings of the economy in the short-run and for evaluating alternative policy options. Apart from the omission of many innovations of Keynes, the IS-LM synthesis overshadowed social philosophy and a set of paradoxes that Keynes sought to bring to the center of economic discourse. In my judgment, the overlooking of the social philosophy chapter of the *General Theory* and the paradoxes Keynes revealed,

has limited the ability of national policy makers to learn important lessons from economic history. It is not therefore surprising that the world has been reliving historical mistakes at increasing global costs.[7]

Doing Economics

Economics has been a part of my life since 1976. Before encountering economics, I encountered many other things and had many other experiences. Therefore, while economics has influenced my life since 1976, many other things have influenced my learning and my doing economics. Indeed as I reflect on my career since 1986, I find that my learning and doing economics has evolved through three phases of the evolution of my life. I have chosen for convenience to classify the phases as the secular phase, the transition phase and the spiritual phase.

Each phase has been shaped, I believe, by how my answers to two key questions have changed. The questions are first, *what is the meaning of life*? Second, *what is the purpose of life*? These two questions are mere summaries of the questions I had been asking since my childhood about which I could not get satisfactory answers: Why am I here? Where will I end? How will I end? When did the world begin? What was there before it started? Will it end? If so when? How will it end? What will take its place? What is the physical beginning and end of the "world" (or universe)? Can there really be a point of physical ending? The more I reflected in my young mind, the more confused I got and because my thoughts were introverted, I could not find answers from where I sought them (my limited mind and even more limited experience).

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[7] Keynes presented the social philosophy that he hoped *The General Theory* will lead to in Chapter 24 the concluding chapter. First, he faulted the failures of the capitalist society to "provide for full employment and its arbitrary and inequitable distribution of wealth and income". Two of his innovations, the *marginal propensity to consume* and the *multiplier* indicated that demand not investment was the driving force of economic growth. In addition, the Keynesian savings function unlike the classical model indicated that income was the key determinant of savings and that a higher savings rate did not necessarily stimulate growth. The implication of the two innovations and the savings function being that the orthodox argument that income inequality was necessary for growth had no foundation. The social implication was that income inequality and arbitrary distribution of wealth had no scientific or moral justification. Keynes also argued that rentier capitalism was bad for growth. Therefore, government should socialize capital to eliminate rent on capital and, the rentier capitalist. Unfortunately, as orthodox economics thrive, so has the rentier capitalist.

I will briefly review each phase and how my doing economics and my view of economics evolved. Before that, I believe that I need to clarify what I mean by secular phase, transition phase and spiritual phase. The etymology of the word secular, which is from the Latin word *saecularis* meaning "worldly" or "temporal", asserts the independence or separation of the "temporal" from religious influences, values and institutions.[8] Applied to learning and doing economics; my view was that *economic phenomena are temporal and are thus, best understood using the human mind and senses and humanly developed ontological approaches and methodologies*. This was my dominant position all through the period I trained to do economics. However, my lingering doubts about economics deepened when the World Bank and the IMF under the control of the leading economies began imposing the theoretically unsound structural adjustment programme on Sub-Saharan countries with disastrous consequences. Globally, as liberalization gathered momentum and spread rapidly after the collapse of the Soviet Union, I began to view economic thought as a tool of strategic games between asymmetrically advantaged countries in their strategic plans to secure strategic advantages globally, particularly in weaker countries without any concern for the welfare of the citizens of the "worsted" countries After much debate with my research collaborator (Kassey Garba) over several years, I began to extend my focus to all points of disadvantages: class, group, gender, national and regional.

As I studied the concrete economic games and their asymmetrical payoffs along class, gender and nation, and regional lines, I experienced and resisted repeatedly, the institutionalized structures that the promoters of international research networks developed to control and limit the depth and scope of conceptual work by African economists. With the blend of Zaria and Ibadan, I freed myself from *conceptual and domain bondage* and interrogated more intensely and more deeply the foundations of orthodox economics [Garba, 1999). My interrogations, readings and reflections in an environment increasingly opened to transcendental experiences, gradually altered my view about the separation of economics from transcendental systems of meanings. My final intellectual liberation led me eventually to where I am in learning and doing economics.

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[8]George Jacob Holyoake, reported as the first to use the term secularism in 1851 sought a social order separate from religion on the grounds that "there is light and guidance in secular truth, whose conditions and sanctions exists independently, and acts forever" (quoted from www.wikipedia.org/wiki/Secularism)

Figure 2 shows the effects of the *post-graduation changes* on the framework I designed from Ibadan during the *transition phase* and during the *spiritual phase*. In the transition phase, I reflected on and wrote more about philosophy and methodology of economics giving more attention to key economic concepts: economic man (*homo economicus*), scarcity, choice, preferences, consumer, producer, production, consumption, optimization and so on. Thus in Figure 2, the concept of *homo economicus* and perfect competition became parts of the foundation.

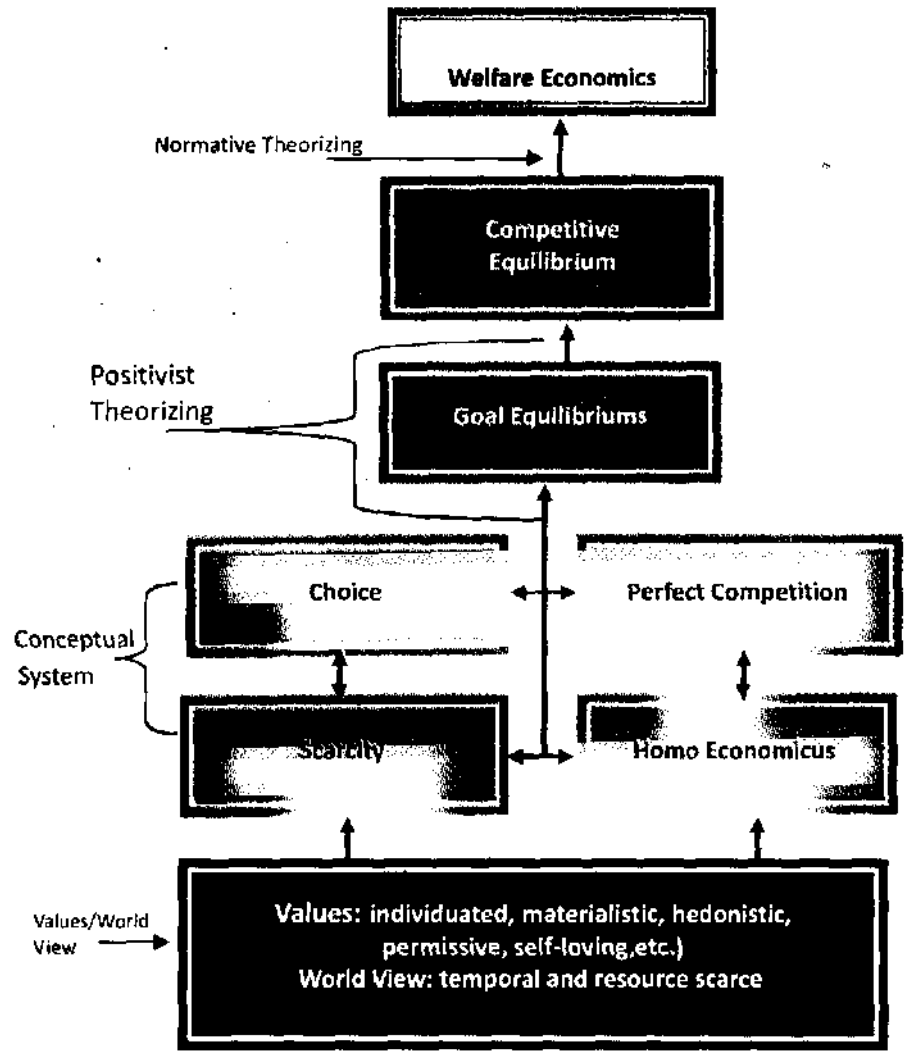


Figure 2: *Deeper Insight into Orthodox Economics*

In the spiritual phase, it became clear to me after reading John Stuart Mills (1836), William Stanley Jevons (1877), Lionel Robbins (1935), excerpts of Aristotle's *Nicomachean Ethics*, Earle (1992) and Russell (1972) that beneath the elegant superstructure of economics lay vices: materialism, hedonism, self-love and permissive values. This realization influenced my transitions particularly, in perspective. I began to see economics as more than a cognitive enterprise: but more increasingly as a cognitive enterprise that promotes (1) *cognitive control* over the minds of the economists and non-economists and (2) the interests of capitalists and in recent decades, the interests of the least productive capitalists: the rentier capitalist. I also took a more careful notice of Keynes warnings about (1) how easily one could be a slave to defunct ideas; (2) the dangers of hostility to change and (3) the dangers of applying expired ideas to new problems.

I will return to Figure 2 later to develop my core argument that *economics needs a new foundation*. Before that I will provide an overview of my learning and doing economics as my knowledge and understanding developed.

Phase 1: The Secular Phase

When I began my university career in 1986, I believed I had a good answer to the question *what is the meaning of life*. In my mind and in the way I lived, I was convinced that it was the *value of my work* to family, to students, to the society and to the nation that made my life meaningful. I did not believe in the accumulation of material wealth or in esteem (position and power) seeking as the primary goals of a meaningful life. I therefore, neither desired nor sought to be materially rich beyond the threshold to meet my material needs and social responsibilities. Neither did I seek positions and power to gain esteem or wealth.

My primary goals were to be a sound teacher of economics, a creative reader, thinker, researcher and writer and a useful member of my family and society. My notion of creativity was to think outside the box of "*ceteris paribus*" that is, the box of "other things being equal" to find better ways of understanding how economies work globally and nationally. I was also motivated by my teachers,

the enthusiasm of my students and many of life's lessons I picked up from books, documentaries and relationships.

As a teacher, my goals were to teach the courses I was assigned (mainly mathematics for economics and macro-economic theory in the early years) as best as I could and to encourage students to understand basic relations in economics and the basic mathematical tools for analyzing the economic relations. In addition, I was particular about students acquiring capacity to apply economic tools to the analysis of concrete economic phenomena so that wherever they worked after graduation, they would be competent and add substantive value to the society.

My research focus was influenced by my mentors, by research opportunities and by interests in development oriented policies. Between 1987 and 1992, two of my mentors were most influential. First, in 1987/88, Professor Ojowu gave Musa Rabiu (a colleague) and I the opportunity to work with him on a study on small scale food processors funded by the Social Science Council of Nigeria (now Social Science Academy of Nigeria). The opportunity enabled me to acquire skills for framing research questions, questionnaire design, data collection, processing and analysis, report writing and presentation.

In 1990, Professor Kwanashie after supervising my M.Sc. Thesis from 1987-88 and supporting my PhD programme in Ibadan gave Isaac Ajilima (my colleague and friend) and I the opportunity to work with him on two Rockefeller Foundation funded studies on Agricultural Supply Response from 1990-92 administered by the African Economic Research Consortium (AERC). These produced two articles in the *Nigerian Journal of Economics and Social Studies* (NJESS) and two monographs published as AERC Research Papers Nos. 57 and 78.[9]

Between the collaborative projects, I published five papers that reflected my interest in development oriented policy and concern about policy autonomy. This was in the wake of the policy capture by the World Bank and the International Monetary Fund and

[9]The articles are Kwanashie, Ajilima & Garba (1997) and Garba, Kwanashie & Ajilima, (1998). The monographs are (Kwanashie, et al., 1997) and (Kwanashie, et al., 1998).

the Club of "donors" turned Club of creditors (the Paris Club). My first publication was a contribution to a departmental project *Economic Update*, which was published in 1987. My contribution on pages 55-58 was titled "Income and Company Tax". It demonstrated my bias towards equality, self-sustaining growth and the policy of following up criticisms with solutions. After assessing the income and company tax policies in the Structural Adjustment Budget of 1987 using standard Keynesian macroeconomics, I concluded that very little would be achieved. However, in going beyond criticisms, I offered that the "key to the ultimate objective of economic development of Nigeria lay in economic independence (that in turn, depended) on an indigenous technological base and control among other factors". To achieve an indigenous technological base, I recommended increased public funding of research, the setting up of an innovation commercialization board and "a framework of structural transformation plan of action". The justification for the framework of a structural transformation plan of action was that developing an indigenous technological base could not be accomplished in the structural adjustment budget that I was convinced was a self-serving foreign imposition. (Garba, 1987).

Mr. D. D. Bolaji and I at the 1990 Annual Conference of the Nigerian Economic Society (NES) developed further, the issue of an appropriate technology policy for Nigeria (Bolaji & Garba, 1990). Based on a conceptualization of technology as a system of reciprocal and complementary relationships between socio-cultural and technical forces, we argued that the idea of technology transfer which anchored technology policy was doomed to fail. This was because socio-cultural forces that interact with technical forces (basic science, engineering science, cybernetics etc) in a technological system are not transferable. The paper then recommended that Nigeria must create a technological system if it wanted to develop. The paper argued that a technological profile of the traditional and modern technological sub-systems was necessary for technology policy. It thus offered an outline of a technological profile and, the associated short term, medium term and long term policy to help Nigeria create the technological system that will drive Nigeria's economic development.

Structural Adjustment was a major area of research for me from 1987-96. In 1989 while I was rounding up the course work for

the PhD programme in Ibadan, Professor Sesan Ayodele, who was with the Nigerian Institute for Social and Economic Research (NISER) at the time, encouraged me to write a paper for a conference of the West African Economic Association (WAEA) which held in Lome, Togo in May 1989[10]. The paper, which was accepted for the conference, evaluated the performance of ECOWAS Agriculture under the World Bank/IMF Structural Adjustment Programme (SAP). The paper was critical of (1) the neoclassical counter-revolutionary paradigm which supposedly anchored SAP and (2) the West African countries that accepted and canvassed for the implementation of SAP. The criticism against SAP was that it deliberately poorly framed the analysis of the problem of agriculture in West Africa to produce solutions (liberalization) that served the United States, Japan and the European Union who still protected their agriculture. The paper criticized the leaders of ECOWAS nations for undermining their individual and collective interests because SAP conflicted with the reasons for and the goals of ECOWAS. The paper offered insight into US agricultural policy as articulated by Hubert H. Humphrey and explained why it was necessary for policy makers in ECOWAS to appreciate the hostility of the interests that are embedded in SAP to the development goals of ECOWAS countries. It urged policy makers in ECOWAS countries to reject such policies in favour of a meaningful economic cooperation and integration which was the primary reason for the formation of ECOWAS in 1975.

In all, I published 12 papers on different aspects of structural adjustment in journals, monographs, conference proceedings and books. Most were first presented in seminars, research workshops and conferences in diverse locations: Lome, Abidjan, Nairobi, Uyo, Manchester and New York. Of the 12, three were theoretical papers and the rest married theoretical and empirical methods to evaluate the theoretical foundations of SAP, the asymmetrical games of structural adjustment and the asymmetrical pay-offs of SAP. A key argument in some of the papers was that SAP was not anchored in

[10] Indeed, my gratitude to him and his family is considerable. First he deepened my understanding about the value of humility and second, he made his home a welcoming place for me and his family was very kind to me. I pray that God will bless them abundantly.

the letters of neoclassical economics but, in the spirit.[11] Second, SAP conflicted significantly with macroeconomic theory in two key areas: *instrument-target relationships* and *counter-cyclical policies*. The targeting principles require that specific instruments target specific problems yet structural adjustment did not target specific problems of Sub-Saharan countries and was falsely branded as a growth-oriented policy (Garba, 1996).

Had the United States, Japan, the European Union, the United Kingdom and China adopted the type of fiscal austerity and monetary restraints contained in SAP in 2007-08 when the global financial crisis raged, the world would have sunk into a greater depression than it did from 1929-33. It is standard macroeconomics that deflationary policies such as SAP do not stimulate growth. By forcing spending cuts, deflationary policies starve economies of the fuel they need for growth. With public spending cuts, public employees lose jobs causing their incomes and consumption to fall. Falling incomes and consumptions have adverse effects on business revenues and profits, business investments and job creation. The recent experiences of Greece and Spain with externally imposed austerity and the consequences (record levels of unemployment, falling incomes, consumption, investment and growth as well as social and political crisis) support Keynesian macroeconomic postulates.

The theoretical papers raise the question why would policy makers in Nigeria accept to implement SAP? The papers (Garba, 1996, 1997 and Garba &Garba, 1997), used games theory to show that were the policy makers fully informed, free to choose and were altruistic agents of their nations, they would not have chosen SAP which was adversarial to the interests of their principals and often required violent suppression of the same principals. The paper suggested that the policy makers chose SAP because they were un-free, naïve, self-loving or some combination of the three. Whatever was the case, the economic costs in terms of lost growth and welfare

[11] The letters of neoclassical economics are given by its foundation, theories and predictions while its spirit is its preference for markets and liberalization. SAP emphasizes liberalization and markets and is therefore, consistent with the spirit of neoclassical economics. However, SAP violates a key principle of choice theory that is, free will. It was an imposition of Sovereign Creditor cartels (Garba and Garba, 1997).

was significant. It is generally accepted that the decade of SAP (1980s) was a lost decade for Sub-Saharan Africa.

Two experiences gave me greater insight into policy challenges in Africa. The first was at a conference in Zaria in 1990 when I presented a paper on "Understanding the Nigerian Inflationary Process: A Case for Inquiry". The paper challenged the notion of inflation as a sustained rise in prices which was the orthodox definition of inflation. I was convinced that *inflation should be more generally viewed as a problem of increase in prices and that sustained increases in price was a special case.* Further, that if policy makers were concerned about welfare, the more general concept was better because even a one period increase in prices such as an increase in prices of petroleum products could have significant short term and medium term impact on relative prices, output and productivity growth, real income, income distribution, consumption and welfare. I therefore argued for research that will illuminate the inflationary process such that both monetary and fiscal policies could benefit from the light. The response of the policy makers at the conference surprised me. Though convinced by the core argument, they did not have the patience to inquire about the nature of the inflationary process before making policies. They were far more interested in doing something than in doing the right thing. As I remember our dialogue; their main question to me was: while we wait what do we do? *This was my first encounter with the research-policy divide and the impatience of Nigerian policy makers with policy research.*

A year earlier in 1989 I had learnt another lesson in the research-policy divide: *the hostility of key agents of global industry of (under) development finance to ideas that challenge policy capture by global economic powers.* Structural Adjustment was probably the most successful policy capture in post-colonial history for through SAP, a few powerful countries controlled the domestic policies of a majority of countries using multilateral organizations (World Bank, the IMF and the WTO) and creditor cartels (Paris Club and London Clubs) in an unfair game of surplus appropriation. It became a common experience for foot soldiers (local and foreign) to vigorously defend policy capture. My first experience was at the Lome conference. After my presentation, some of the "development partners" were not impressed by my arguments and said so clearly

foundation for the study of African economies. My argument was simple. From my reflections on orthodox and Keynesian economics, it was clear to me that (1) the institutional assumptions which derived from Anglo-Saxon societies were embedded in both theories; (2) the truth of the claims made by the theories depended on the institutional assumptions and (3) African institutions differed from those of Anglo-Saxons. Therefore, following the logical structures of orthodox and Keynesian theoretical systems, it is African institutional foundations that ought to be at the foundation of studies of African economies. I had the strongest "attacks" from employees of the World Bank incidentally those from Africa and South East Asia. It was therefore, a great surprise to me when one of them talked about institutions at an AERC Plenary in 1995 and shortly after, the World Bank's World Development Report 1997-98 recognized formally the role of institutions. The positive outcome from the meeting was that I became aware of Douglass North's work on institutions and, I became even more convinced that in researching policy, the role of institutions must be part of its foundation.

One of the first policy studies that gave prominence to institutions was the AERC funded study "The Determinants of Federal Government Expenditure: 1970-93". After my PhD programme, I stopped treating government expenditure in Nigeria as exogenous contrary to its treatment in Keynesian models. With an unstable fiscal anchor - oil revenue - federal expenditure was better modelled as reaction functions. In addition, rather than the ontological approach of positivism, a documentary analysis of Federal Budgets from 1970 to 1993 was preferred as the context for identifying and formalizing patterns. The documentary analysis (1) confirmed oil revenue dominance and (2) revealed regime specific budgeting philosophy and practices as well as patterns of federal expenditure reactions to changes in actual revenue.

The research was subsequently extended in three directions. The ***first direction*** was a result of exploratory analysis of debt data in July 1995 when I was a Visiting Scholar to the IMF at the conclusion of the federal expenditure study. I observed some relational irregularities between debt stock and debt flows in the published data on domestic debt. The observation and analysis of its implications, led me, upon careful reflection and analysis, to write a

paper for an in-house seminar at the Research Department of the IMF. The seminar was kindly organized by Mr. Mohsin Khan who at the time was in charge of the AERC-IMF Visiting Scholar Programme.[14] At the end of the meeting, it was decided that I needed to pursue the issue further. I did and wrote a proposal on the problem, which the AERC kindly funded. The study produced the research report "Federal Domestic Debt in Nigeria: Structure and Growth" and the article "Nigeria's Domestic Debt: Resolution of the Stock-Flow Puzzle and Generation of a Credible Data Set" published by Nigerian Journal of Social and Economic Studies (NJESS) in 1998. At the end it turned out that there was no puzzle but, a lack of clarity in the documentation of data. The key lesson was that it was important for organisations collecting and disseminating data to accompany published data with adequately clear notes. Also, users of data should understand the data they are using before using them for analysis. The contributions of the study were (1) formalization of the framework for domestic debt management; (2) inference about how management of domestic debt weakens fiscal policy by allowing government to avoid the disciplines imposed by budget constraints and (3) fiscal indiscipline makes monetary policy secondary and an accomplice in the weakening of fiscal policy.

The ***second direction*** for the policy research began after the completion of the domestic debt study. It was some synthesis of the expenditure study, the debt study and the PhD study on external shocks and policy response. The second Visiting Scholar appointment at the IMF began after the completion of the domestic debt study. I used the opportunity of the visiting appointment to present my ideas of a formal framework of federal budgeting in Nigeria. I prepared and presented the paper "Political Shocks and Federal Fiscal Operations in Nigeria, 1975-93 at the IMF Research Department Seminar on June 26, 1997. This was probably my first foray into political economy and the main point is that political shocks were as important as external shocks in shaping fiscal operations at the federal level. It thus formalized the centralized

[14] The paper presented was titled "Fiscal and Domestic Debt Policies and the Growth of Domestic Debt in Nigeria: Preliminary Observations".

fiscal system built under military rule and its implications for Nigerian public finance.

Feedback from the seminar influenced a further development of the framework in the 1999 paper "Regime Change, External Shocks and Federal Fiscal Operations in Nigeria: 1975-93" (Garba, 1999). The paper modelled federal fiscal operations in the context of regime changes and external shocks using stylized facts of the fiscal operations. The stylized facts revealed a dual short-term fiscal process structured by Nigeria's fiscal and monetary laws, a dominance of oil revenue and discontinuities in political regimes.

The paper modelled two parts, *budget targeting process* and *implementation deviation. Implementation deviation* was a key factor in the budget process because the unstable fiscal anchor made a significant implementation deviation most likely in every budget cycle. This raised the question: when actual revenue deviates significantly from estimated, how does government expenditure and government borrowing respond? The paper showed that the responses depended on the regime particularly its expenditure preferences, complementary policies and the presence or lack of an in-built stabilizing mechanism in the budget.[15] The model has two important implications for econometric analysis of the budget process. First, structural coefficients are not fixed – they are sensitive to political changes. Second, implementation deviation is sensitive to changes in the parameters. These discontinuities render regression estimates of budget parameters of limited use since parameters average out moving parameters.

The ***third research direction*** was in the area of *harmonizing fiscal and monetary policies*. The problem of fiscal dominance was a recurring theme in the policy research papers. For instance, the domestic debt study concluded that "the institutionalized subordination of monetary policy to fiscal policy and the legalized

[15] For instance, the Shagari administration (1979-83) built in stabilizers into its capital budget by tying a part of its capital budget to oil revenue that exceeded a pre-determined threshold. When oil revenue was above the threshold, the capital expenditure adjusted almost automatically. The key challenge however, was when oil revenue significantly undershot targets as it happened in 1981. The one-sided built-in stabilizers failed, it triggered the fiscal crisis of 1981. The persistence and deepening of the crisis offered some justification for some regime changes in 1983 and 1985.

impotence of the central bank weaken both monetary and fiscal policy". The conclusion implicitly suggested that improving policy effectiveness demanded greater harmony between monetary and fiscal policy. The challenge however was; *how could harmony be achieved?* The paper "Harmonizing Fiscal and Monetary Policy in Nigeria: A Preliminary Analysis and Suggestions for Further Research" offered some preliminary guidelines. The value of the paper however, lay less in the guidelines but in the areas of ignorance which needed knowledge before fundamental changes could be made. Probably recognizing earlier experience with policy makers and the impatience with research, the paper recommended an incremental approach to improving harmony. It showed that the monetary programming framework used by central bank in the conduct of monetary policy achieved the wrong type of harmony - monetary policy accommodated fiscal policy. The desired harmony was one that strengthened both fiscal and monetary policy and that required fiscal discipline to be binding on fiscal operations and the operation of monetary policy to discipline fiscal spending. The incremental approach was a system of progressive improvements to the monetary programming framework through a progressive research programme which required:

a. a clearer and formal model of inter-governmental fiscal relations and the budget process;
b. a model of the analytical statement of the balance of payments;
c. structural and institutional analysis of the money, currency and capital markets; and
d. a model of the real economy that shows how value is created, distributed and utilized.

The target was a framework that empowers policy makers "to anticipate and plan for smooth adaptations to the dynamics (and contrived volatilities) of globalization . . . (and which) minimizes *over time, the sensitivity of the macroeconomic policy regime to* external shocks transmitted by the dynamic forces of globalization".

Gender Studies

After the consensus on gender (and on other matters), Dr Precious Kassey Garba and I began a very fruitful intellectual

collaboration that produced theoretical and empirical papers on gender, globalization and conflicts. The collaboration enabled me to work directly and indirectly with several gender-based groups such as AAWORD, Women's Research and Documentation Centre (WORDOC) and the International Working Group on Engendering Macroeconomics and Trade Theory. Our studies explored themes such as "Trade Liberalization, Gender Equality and Adjustment Policies in Sub-Saharan Africa"(Garba & Garba, 1997); "Economics of Adjustments and Group Interests" (Garba & Garba, 1997); "Engendering Macroeconomics and Policy for the Development of Africa: Options and Prospects"(Garba, 2003) and "Towards an Engendered Macroeconomics for the Development of Africa"(Garba & Garba, 2008).

The collaborations often *married* gender equality issues to asymmetries in the global trade and financial architecture to illuminate asymmetries at four levels of social aggregations: micro, meso, macro and global. The studies show that asymmetries and disadvantages are not only multi-level, they tend to be re-enforcing. Also, that most international gender analysis tends to limit focus to national and household level asymmetries whereas, for most Sub-Saharan Africans, the global asymmetries strongly reinforce national and household gender asymmetries. Thus there was ample room for African women and men to collaborate to minimize marginalization at household, national and global levels.

One of our major collaborations that we have not yet published is an essay titled: "Gender, African Development and Global Interdependence: Challenges in the 21st Century". Written in 1999, it was a synthesis of most of the gender papers up to that point. We thought that the dawn of a new century offered an opportunity for deep reflections about gender and the development process in post-colonial Africa and to visualize the future against the background of dangers, possibilities and hope. Like other gender papers, the paper formalized a thinking device anchored in a network of relations that evolved historically. After due analysis and evaluation of western thoughts (orthodox, Stieglitz's view of development, the third way, proposals for International Banking Standard), Western institutions, organizations, values, technological changes and international payments and trade, the paper revealed a

set of resilient domestic and external obstacles to Africa progress towards gender equality and economic development.

The set of internal obstacles included: post-colonial opportunity and incentive systems that favour treasonable felons, autocrats, femocrats, etc; patriarchy and, "colonial ties and relations which keep African politics, economics, region and regional cooperation unstable and vulnerable". The external obstacles are: (1) western dominance of global politics, economy, international law, etc, which confers on them overwhelming strategic advantages; (2) tendency of western institutions and organizations to polarize genders, people and nations and to reinforce global and national inequalities; (3) duplicity and prejudice inherent in Western values, institutions and organizations. The paper offers for discourse, two ideas: (1) *active thought* and *thoughtful actions* as alternatives to *idle thought* and *thoughtless actions* and (2) an alliance of the dis-empowered African men, women and children to challenge the domestic and external obstacles.

In a more recent work on *Engendering Macroeconomics*, we observed that the main types of disadvantages - gender, class, group and national – tend to be interacting and reinforcing. For instance, a woman in a marginalized nation is more likely to be disadvantaged compared to a woman in a marginalizing nation. Also, a woman whose group is marginalized is more likely to be marginalized than a woman whose group is advantaged. Generally, the more disadvantaged a nation, a group and a class is; the more disadvantaged are the women who belong to them. Given the nexus between gender, class, group and national dis-advantages we asked the question:

> why do human social, economic, political and intellectual network of relations at micro, meso, macro and global levels tend to be asymmetrical producing gender inequity, conflicts and instabilities? (Garba & Garba, 2008).

The question generated two related questions: (1) can humans engineer transitions to non-asymmetrical network of relations and payoffs? (2) if so, how can they do so? It is obvious now; that what is required is a transformation and not just a transition. For equitable, just and fair human social, economic,

political and intellectual systems cannot be built on existing human systems of meanings, values and motivations. The paper argued that any engendering of economics that is built on orthodox economic foundations cannot produce insight for making the world equitable, just and fair because equity, justice and fairness are in direct conflict with the core values of materialism, hedonism, self-love, permissiveness, etc that are the core values of orthodoxy. The paper thus recommended a discourse to rethink the concept of values embedded in orthodox economics among a set of philosophical questions that required answers.

In addition to our collaborative work on gender, I published two theoretical papers on gender. The first offered a gender model of production and households (Garba, 1997). The model extended the works of feminists such as Diane Elson leading the drive to engender macroeconomics. There were two main extensions. First, an extension of the two sector model to a five-economy disaggregation of production. Second, differentiation of labour by gender and skills, production technologies by capital input and government-provided infrastructure by location as well as a differentiation of households by gender and employment of head. The gender dis-aggregations produced gender variables that enabled analysis of their determinants and to predict the possible effects of adjustment on different classes of women. Some of its key predictions were that SAP would adversely affect growth in the supply of skilled women workers, gender equality in households; efficiency of reproduction and welfare of women.

The second paper was part of the engendering project and it had the ambitious goal of developing macro-institutional tool for thinking about three types of disparities in Nigeria: space, gender and class. In the set of stylized facts were rules, games, players and the Nigerian environment. In the research towards writing the paper, I came across a short quote that had a profound effect on me. The quote was:

> The basic tool for the manipulation of reality is the manipulation of words. If you control the meaning of words, you control the people who must use the words (Phillips K. Dick, 1986)

From this point onwards, I began to pay much closer attention to words and their meanings. It influenced my subsequent research on the industry of sovereign lending branded as development finance and on philosophy and methodology of economics. It eventually led me to undertake conceptual analysis of key concepts such as scarcity, value, income, *homo economicus*, production, and so on.

The paper focused on real issues of disparities that have been identified as constraints to Nigeria. Professor Sylvester Abumere in his inaugural address had concluded that "distributional inequity is doing havoc to our national development, affecting ethnic harmony, damaging our social cohesion and ruining our politics" (Abumere, 1998). The paper thus expanded on the set of disparities and sought to offer a device for clearer thinking about disparities.

The paper rejected parsimonious generalizations that are blind to real human issues (spatial, gender and class disparities and asymmetries) and to the human cost of their blindness. It chose instead to draw attention to the real issues and their real costs through a tool designed to aid clearer thinking.[16] In developing the tool, the paper followed *"the visible hands of facts"* and the author's introspections about concepts and processes, and judgement about the desirability of equity. The paper articulated the method appropriate to the problems of disparities:

> We propose therefore, that information on Nigeria's rules of human interactions (institutions), players (organizations), their interests and strategies; interactions and the environment within which (the interactions) take place are the logical and factual points of "analytical take-off". Therefore, we begin with an acquaintance with the Nigerian environment, institutions, players and the games and then deduce from it, a macro tool with potentials for aiding inquiries into Nigeria's spatial, gender and class disparities.

In sketching out the tool, the paper adopted a *method of reverse summation*. The method is shown in Figure 3 below. It

[16] The idea by Keynes that a model is a device for thinking influenced this paper(Keynes, 1994).

begins with macroeconomic variables. For each variable for example, Gross Domestic Products (GDP) which is defined as value added of final goods and services, the paper reverses the summation to locate the points of interaction and decision making that generate the observed economic variables. The method was neither Keynesian nor orthodox and indeed, it required freedom from orthodox concept of value and income to include the reproductive and subsistence sectors in the analysis.

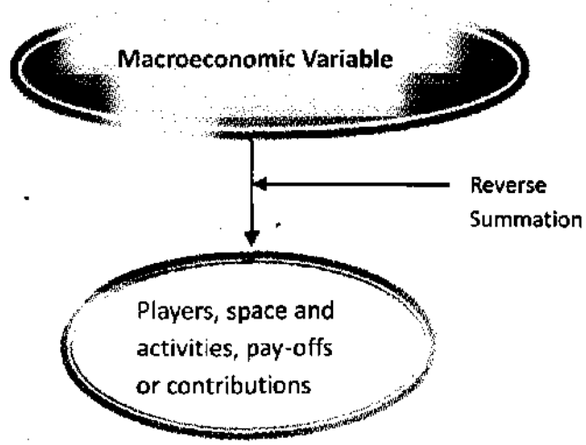


Figure 3: Reverse Summation Process

As a reasoning device the macro-institutional tool drew attention to spatial, class and gender problems of Nigeria and offers explanations for some of the puzzles in Nigeria such as the high levels of poverty in the Niger Delta despite the oil wealth and shows why direct transfers to citizens in the Niger Delta is a possible way of reducing poverty and gender inequalities. The model also reveals some key areas of subsisting ignorance (unknown values, unknown externalities and unknown parameters) that need to be overcome to make thinking about spatial, class and gender problems of Nigeria clearer.

[17]Keynes thought in terms of aggregates and as he explained on page 37 of the *General Theory*, until he had settled the problem about "the choice of units of quantity appropriate to the problems of the economic system as a whole" he could not proceed. In orthodox economics, the procedure is from atomistic agent to market to economy.

Globalization and Conflict Studies

Most of the globalization studies were conducted between 2000 and 2004 and focused on the sovereign credit games, behaviour of government and globalization of finance while the conflict studies investigated the problem of open conflicts when states, institutions and markets are failing.

At the millennium conference of the Nigerian Economic Society in 2000, I presented a paper on "The Economics of the Relations between Official Lenders and Governments of Sub-Saharan Africa (SSA) Countries". Phillip Dicks insight about words influenced this paper. At the onset the paper identified two key constraints to understanding financial flows between sovereign lenders and sovereign borrowers. The first was analytical biases and the second, conceptual ambiguities or manipulations. The paper undertook a conceptual analysis of the concepts of Official Development Assistance (ODA) and its components; grant, loans and other development finance and donors. It shows that ODAs are essentially sovereign lending facilities (SLF) provided by rich nations to capital scarce developing nations at conditions that favour the rich nations. Also, the word "donor" or phrase "donor community" misrepresents what providers of tied grants, tied credit, multilateral credit and bilateral debt restructuring really are. They are rational and strategically advantaged sovereign players who deploy all their advantages shrewdly to secure the maximum possible pay-off for their stakeholders. The development of a supply-leading "global industry of development finance" where the supplier is king is probably, the most successful *sovereign con-game* of all times. It was not accidental that by the 1980s, the real nature of sovereign lending and borrowing game became clear with the Paris Club and London Club of debtors working together with the World Bank and the IMF to capture the policy space of first, the most externally indebted countries and gradually most poor nations.

The paper hoped that by illuminating the essential nature of the game of development finance and its asymmetric nature and pay-offs, that sovereign borrowers like Nigeria would be better informed and alter their strategies from naivety and passivity to the informed and strategic. However, as Nigeria's external debt rose steadily, I sought to understand why the Nigerian government was responding seemingly naively and passively. "Globalization and the

Nigerian Economy: Behaviour of the State and the Economic and Social Consequences"(Garba, 2004), was the product of my research and reflection. I reflected on the behaviour. The paper uses game theory to analyze the behaviour of Nigerian governments. It shows differential behaviour in international games (passivity); collusion in a few states vs. non-state games (e.g. oil and gas) and Stackelberg leadership in games involving asymmetrically disadvantaged non-state players. It also showed logically and empirically that international passivity was the most costly in terms of macroeconomic stability, economic competitiveness and high and sustained social costs. Further, with the twin problems of national failure and asymmetries of information, the state was unlikely to act strategically in global settings. Yet, if the state fails to act strategically in international games and in oil and gas games, the marginalization of Nigeria will be progressively sustained. The behaviour of the Nigerian government puts at great risk the future of Nigeria as a viable state.

A subsequent paper on conflicts explored this theme further. The paper "Open Conflicts when State, Institutions and Market Fail: The Case of Nigeria" (Garba & Garba, 2002) was commissioned by the AERC as part of the AERC/IEA/World Bank study on post-conflict economics. The paper had two parts: a theoretical part and an empirical part. The theoretical part challenged the explanations of post-Structural Adjustment conflicts in Africa in terms of blood (ethnicity), babies (population) and motives (grievance and greed). It argues from philosophical and historical perspectives that conflict is inherent in human beings also, a driving force in the evolution of human societies.[18] In establishing social order that allows people to resolve their differences peacefully, human beings have laid claims

[18]Viewed as a struggle between antithetical forces, conflict could be inherent (an inner struggle) or open (when the antithetical forces fight). Arguably, all humans face some type of inherent conflict –passion/pleasure/prudence; mind/matter; duty to God/Duty to State; good/evil, etc. The history of human societies also reveals antithetical forces: order/anarchy; state/citizens; social cohesion/individual liberties; slave/masters; tradition/modernism/postmodernism/; science/religion; capitalist/worker; socialism/capitalism; debtor/creditor; unlimited wants/limited resources; and so on.

to being civilized. Philosophers thus treat social order as a virtue achievable within states.[19]

The paper argued that social orders were key to understanding conflict also, that in a period of global transitions, turbulence and insecurity, it was reasonable not to overlook the link between national and global social orders. It identified three key elements of a national social order (the state, the institutions and markets). It then proposed that *when the three elements of a national social order fail, open conflicts are likely to become more prevalent within the nation*. The existence of a global social order required analysis of the nature of that order and its relationships to national social orders. The paper thus established (1) a nexus between global and national social orders and (2) a threshold for the failure of national social orders. It then applied the threshold analysis to Nigeria and concluded that the Nigerian state, institutions and markets were failing. Also, that the global social order is a destabilizing force because it was built to favour the strong and the advantaged and to enable them take advantage of the weaknesses of weaker nations. The paper ended thus:

> The failures of national social orders in weak countries could not be legitimately isolated from the failures of a global social order. For humanity as a whole therefore, the failure of the global social order poses the greatest danger to peace. But then, are humans chasing illusions or simply being inventive?[20]

Two papers on globalization of finance pursued further the thesis that the global social order was (1) biased against weak

[19] Aristotle believed that political society exist for noble actions and without a state man was worse than a beast. Both Aristotle and Plato offered philosophical contemplations of the ideal state in *Politics* and *The Republic* respectively. Of course, they disagreed about what state was ideal and humans have not developed ideal states.

[20] This rhetorical ending puts to question the willingness of strategically advantaged nations to subordinate their self-interests to promote the common good of all humanity. Peace will be elusive if the strategically advantaged are unwilling or unable to resist the temptations to exploit the strategically disadvantaged. It is also possible that the strategically advantaged may be inventive in leading the world in chasing illusions of peace.

nations and (2) poses a danger to global peace. The papers were titled "Globalization of Finance after the Bretton Woods Conference of 1944" and "Globalization of Finance: Policy Challenges and Options".[21]Chronologically, the first paper was the foundation for the second. However, the second paper was the first to be published in 2001 by the *Afribank Journal of Economics and Financial Review* while the foundation was published in 2004 by the Nigerian Economic Society (NES). In retrospect, I am convinced that we should have published the two papers as a book because (1) together they reveal the dangers at global and national levels and (2) the conclusions in the papers were almost prophetic for both Nigeria and the global economy.

In "Globalization of Finance After the Bretton Woods Conference of 1944", we traced the evolution of the global financial architecture from its institution building age (1944-70); through the age of great instability and reform (1971-88); the golden age (1990-99) and to the then cloud of impending transition (2000). The paper identified the key multilateral, regional, bilateral and domestic building processes that produced the key institutions (World Bank, IMF, OECD, USAID, DFID, etc), the collusive oligopoly of the industry of development finance, the transition from the "Gold Standard" to a regime of financial liberalization; the changes in domestic financial laws in the United States; the effects on financial markets and financial products; the gradual disconnection of the financial economy from the real economy; the episodic failures of banks and financial markets; the responses of rich countries to banking and financial crisis and the institutionalization of moral hazard and rentier capitalism; the tendency to shift costs of banking and financial crisis to citizens of weaker nations. The paper argued that in the transition from the Gold Standard to the flexible exchange rate regimes, a virus of volatility appeared to have been sown in the heart of global finance. As a consequence a pattern of global volatility began to emerge from the late 1970s: the debts crisis (early 1980s); the Mexican peso crisis (1994-95); the Asian banking and financial crisis (1997); the Russian currency crisis (1998) and the

[21]Professor M. O. Kayode, one of our mentors deserves credit for demanding a paper from Professor Kassey Garba and I, and for comments on an earlier draft of the paper.

Brazilian Currency crisis (1999). In each of the crisis, speculators were bailed out at growing costs. The paper expressed its concern thus:

> In bailing out speculators (hedge funds managers and banks), the US revealed a preference for systemic survival . . . regardless of its economic costs on the welfare of citizens. In the US bailouts, the big players acquired safety and certainty in the knowledge that the United States government would transfer the costs of financial crisis to *foreign victim countries and their citizens. Consequently,* the risky investors and speculators have no incentive to avoid taking the type of risks that precipitate crisis.

Through its arranged bailouts, the paper inferred that the United States had "weakened the foundations of the global financial architecture that had played a commanding role in building." Further, that:

> as long as it is possible for the US and its allies to transfer the costs of financial volatility to others, there would be no sufficient incentive for the US or its allies to negotiate for a more stable, fair and competitive global financial architecture.

The paper anticipated the transition in global power relations from lessons of history and from the emergent signs of (1) the peaking of US power; (2) the ascendancy of new economic powers: China, India and Brazil and (3) the rebounding of Russia under President Putin.

The lesson for Nigeria was offered in the very last paragraph of the paper.

> Regardless of what the future outcomes would be, it is critically important for countries like Nigeria, who are limited to the most inefficient segment of the international financial system, to overcome the illusions that locked them into retrogressive and destabilizing relations. If "developing countries" do not overcome the illusions . . .

> the future of their economies and people may be worse than the present".

The "Globalization of Finance: Policy Challenges and Options" sought more specific lessons for Nigeria in terms of its options in dealing with globalization of finance and the possible challenges. The primary concern was the exuberant way authorities were responding to globalization of finance. The paper identified challenges at multilateral and local levels that needed to be properly understood before engaging more effectively with globalization of finance. One of the key challenges at the multilateral levels was the rules and incentive systems which made financial shocks "more frequent, speedier, more contagious and more destructive". The rules and incentive systems were rigged in favour of rich countries, their banks and speculators. The second problem was that the US was the major referee and its financial institutions were the major players. Because the differences between referee and players are blurred by "the iron triangle of special interests, lobbyists and legislation", financial games could not produce "fair pay-offs". The challenge for Nigeria was (1) how to design and implement rules of engagement that do not subvert chapters II and IV of the 1999 Constitution of the Federal Republic of Nigeria and (2) the quality of refereeing players adept at exploiting loopholes and Nigeria's version of the triangle of special interests, lobbyist and legislation.

The paper was concerned that the "financial referee" the Central Bank was conceding to special interests to deepen and widen the influence of globalization of finance in Nigeria. By rushing to "universalize" banking in Nigeria, the Central Bank was failing to learn the lessons of universal banking in the United States in the 1980s or, from the failure and liquidation of 26 banks in January 1999 which cost 50,000 jobs and about ₦18 billion. The paper also noted that:

> the "fast track approach (by directive) to Universal Banking in Nigeria contrasted with the legislative approach by the United States. In addition, the directive contains ambiguities (especially with conditions for obtaining licenses" and loopholes that license banks could exploit.

The paper warned against the exuberant way Nigeria was engaging with globalization of finance in 2000, noting that Nigeria seems "to be heading exuberantly into the depths of financial liberalization without learning from its own experience with the (borrowing) and import bubbles of the late 1970s to 1982." It advised for a cautious approach that had four key elements: progressive upgrade in the capacities of referees and players to act strategically and consistently with the interests of the nation; reduction of external debt to free policy from its captors; improvement in macroeconomic fundamental and building of economic institutions. The paper ended with three lessons of globalization. First, that self-preservation, deep and clear thinking and good memory are virtuous attributes. Second, dogma is folly; no idea is faultless and ideas embed interests of those that peddle them. Three, prevention is better than cure.

Unfortunately, the warnings went unheeded. We have not estimated the costs of the episodes of banking crisis after that of January 1999 but clearly, the cost has risen exponentially for every banking crisis tends to cost more than the previous.

Theoretical Studies

Several studies made theoretical contributions to gender studies, informal economy, globalization, public finance, sovereign creditor-borrower relations, the coincidence of market failure and state failure; the political economy of oil and gas and so on. Some of the theoretical works in gender studies, globalization, public finance and international finance contributions have been discussed. In this section I will highlight theoretical works in three areas: market failure and state failure; the informal economy and the political economy of oil and gas.

In "Market Failure, State Failure and Pollution in Nigeria: A theoretical Investigation of Two Cases" (Garba & Garba, 2001) we explored what the mainstream literature had not yet fully explored: a simultaneous failure of market and states.[22] We investigated cases of

[22]That neoclassical economists and Keynes have contrasting views about the government is a historical fact. In the *General Theory* Keynes assigned the responsibility of meeting deficiencies in aggregate demand to the state. In addition, he canvassed for a socialization of capital to cause the euthanasia of the rentier capitalist. The neoclassicals on the other hand, distrust governments. Yet,

pollution: gas flares and the case of diesel and gasoline pollution. In the case of gas flares, the market fails because polluters have no incentive to stop polluting and the government fails because as a joint venture partner of oil companies it is also a joint polluter. Limiting quantity of gas flares in the short term will cause a fall in oil revenue which has adverse effects on fiscal operations. Clearly, neither private nor public polluters have an incentive to reduce pollution. As a passive player in joint venture partnerships, the government is not able, even over a longer term to control the quantity of gas flares. In the case of AGO and gasoline flares, polluters have no incentive to reduce pollution and taxes are ineffective because of a lack of alternatives to road transport, poor supply of electricity and vintage carrying units and generators. In both cases that exemplify the simultaneous failure of the market and the state; social (dis) equilibrium is generated with high, persistent and rising social costs.

The informal sector is the dominant sector in Nigeria in terms of contributions to GDP and employment yet, the behaviour of the economic agents are not well understood. In the paper "The Informal Economy and Government Policy in Nigeria: Analytical Implications of Gender Constructed, Geo-Ethnic and Religiously Diverse Agents with Incomplete and Asymmetric Information" we sought to contribute to understanding the behaviour of agents in the informal sector. The paper claimed that when informal economic agents are gender constructed and their geo-ethnic and religious circumstances are heterogeneous, (1) the knowledge problem is not uniform, (2) rationality is to be established not assumed; (3) relations are asymmetrical, (4) choice situations are strategic and (5) the behaviour of economic agents are better understood by observation than by abstract theorizing. The paper offers an experimental research approach as a means of relaxing the knowledge problems of researchers and, the revealed constraints of economic agents.

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even the neoclassicals concede that markets fail for a variety of reasons: imperfect markets, externalities, asymmetries of information and inequalities in distribution of incomes. Neither Keynes nor the neoclassicals however, have a solution for a simultaneous failure of government and markets.

The agitation for resource control seems to be founded on three assumptions. (1) the Federal Government controls Nigeria's oil and gas resources and (2) oil producing states/ethnic nationalities can control the oil and gas resources should the federal government cede control. The paper "The International Political Economy of Oil and its Implications for the Niger Delta Crisis" formalized a political economy framework. The framework (1) formalizes the economics of oil and gas in terms of its strategic and rentier characteristics and (2) uses game theory to show how the rent is contested for and shared. It shows that the economics of oil and gas works against oil producing communities and countries in favour of a rentier global oil and gas industry. Also, international politics of oil and gas work against oil communities and countries. Oil producing communities and governments that threaten the rent appropriated by oil companies are susceptible to foreign threats. Oil producing communities are therefore, less likely to find effective solution to their problems from their government or from the international community.

In a latter paper, we use game theory to show why a cooperative solution is better for all Nigerian players (government, oil producing states, non-oil producing states and oil producing communities) than the status quo. Also, that a cooperative solution would require (1) agreement on a general principle of derivation and (2) strategic management of the oil and gas resources by Nigeria represented by its governments to exploit value at all points on the oil and gas value chain. The oil and gas game can be a win-win game for all Nigerian players. However, unless they cooperate, the global players will win continuously at the expense of Nigeria and a majority of its citizens. Thus, making the right choice requires not only knowledge but also, wisdom and understanding.

Philosophy and Methodology

My major work on the philosophy and methodology of economics was written in 2002 and presented at the Special Session on the Teaching of Economics at the Annual Conference of the Nigerian Economic Society. The presentation was titled "An Essay on the Philosophy and Methodology of Economics". In writing *The Essay* I stood on many powerful intellectual shoulders. Access ironically to many was facilitated by my visiting appointments at the

IMF in 1995 and 1997. During my first visiting scholarship at the IMF in 1995, I had the opportunity to buy several books on philosophy and methodology of economics by Mark Blaug and David M. Hausman that helped to clarify some of my concerns about economics. I also committed to reading first hand, Adam Smith's *Inquiry into the Wealth of Nations*; Cournot's *Researches into the Mathematical Principles of Wealth*, John Stuart Mills' "On the Definition and Method of Political Economy"; William Stanley Jevons' "Brief Account of a General Mathematical Theory of Political Economy" (Jevons, 1866); J. M. Keynes' *General Theory*(Keynes, 1936), Milton Friedman's *The methodology of positive economics*(Friedman, 1953); Terence Hutchison's *Knowledge and Ignorance in Economics*(Hutchison 1977); Karl Marx's "Ideology and Method in Economics"; Thorsten Veblen's "The limitations of marginal utility"(Veblen, 1994); Ojetunji Aboyade's *Integrated Economics*(Aboyade, 1983); Onimode's "Towards New Orientations for Economics in Developing Countries"(Onimode, 1978); Eskor Toyo's "Economic Laws and the Nigerian Economy" (Toyo, 2008) and so on. In addition, I carefully read through W. J. Earle's *Introduction to Philosophy* (Earle, 1992).

When I wrote The Essay, I was deeply concerned about the knowledge content of economics and by the relevance of economics. I had followed the contribution of Mills, Jevons, Marshalls and John Neville Keynes (the Father of J. M. Keynes); the challenges of T. W. Hutchison, the responses of Machlup and the F-twist thesis of Friedman; its untwisting by Musgrave; the heterodox approaches of Marx and Veblen and so on. I also followed Aboyade's argument about the organic beauty of economics –a critic of the micro-macro divide; Bade Onimode's criticisms against the "fundamental incongruence between paradigm and objective reality" and Eskor Toyo's explanation of why economic policies do not work in Nigeria. Eskor Toyo argued that policy failures were explained by a lack of knowledge about the Nigerian economy by teachers and policy makers; the reliance on irrelevant or misguided economic thought for policy design; the dominance of external interests in policy making and, the employment of phony goals to cover up foreign interest driven policies.

At this point in my development, the consequences of *policy capture* was obvious in the growing disconnect between resource

endowment and policy outcomes, and also in clear signs of state, institutions and market failure in Nigeria. As an economist who had been frustrated with the methodology of economics, I began to question the value of what I had learnt, taught and still teaching. I was concerned that we (economics teachers) may not be helping students and policy makers to acquire the type of knowledge for good economic practice and, for good policy making.

In The Essay I used the metaphor of carmakers and drivers to illustrate the problems that students and policy makers may have. I wrote:

> A person does not have to possess *knowledge* of mechanics or internal-combustion engines to successfully drive an automobile. However, car makers have to have *knowledge* of mechanics and internal-combustion engines as elements of a *set* of knowledge they have to have to be successful. Indirectly therefore, the driver *depends* on those to whom knowledge of mechanics and of internal-combustion engines is a necessity. It is reasonable to expect that the car and, the act of driving it are *contingent* on knowledge of mechanics and, of internal combustion engines that car makers have; without the knowledge the car could not exist and the person could not be driving the car.

Then I applied the reasoning to policy makers:

> The typical economic policy maker in Nigeria is like the driver of the automobile, policy predictions of economic doctrine the analogy of the car while the economic doctrine is the analogy of the knowledge required to make a car. It follows therefore, that economic policy action and economic policy success *–in terms of stated goals-* are contingent on the knowledge embodied in the economic doctrines from which policy predictions derive. The cost of knowledge failure is grave to a society just as a brake failure is to a car driver.

And to students:

> The typical student of economics in a typical Nigerian university learns and assimilates *doctrines* of economics and at best, acquires some *know how* (practical skills).[23] Unlike the policy maker who tries to drive the car, the typical graduate of economics hardly attempts to drive the car. Rather, the typical student uses the proof of ownership of the car –the B.Sc. Economics certificate – to acquire a job that often, does not require the use of the type of car the student has acquired.[24]

This led me to pose an epistemological question: "*is the belief of the policy maker that the policies predicted by received economic doctrines justified true beliefs*?" The point of the question is, if the economic doctrine the policy maker is using to make policies is untrue, the policy maker is ignorant about the economy towards which his policy is targeted. Because of his ignorance he is unlikely to choose or implement the right policy. Consequently, neither the output nor the outcome of policies will be sound. Similarly, if teachers of economics are teaching untrue doctrines, then students will graduate in ignorance and become a danger to the economy should they practice in their ignorance. The danger is not just because they will choose and implement the wrong policies (problem of adverse selection) but that their ignorance will breed in them a doctrinaire or rigid attitude anchored in the false confidence that ignorance gives. As I used to tell my students, ignorance is not the problem. The problem is *when one does not know that one does not know*. The individual becomes unwilling to learn and becomes un-teachable.

I therefore put forward four questions that philosophers of science, social science and economics have contemplated: *what is a science*? *is economics a science*? *can economics be a science*? *should economics be a science*? I also put forward two ethical questions: Is it prudent to maintain a belief in the policy predictions of economic doctrines, regardless of experience? Is such a belief morally justified?

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[23] The set includes data collection, data analysis, computer skills, writing skills, etc.

[24] In most cases, the student packs the car acquired in the university and uses that which the employer believes is more useful. Sooner than later, the university acquired car falls into disuse.

To the situation of the student/graduate of economics I posed additional questions: Does the graduate of economics *know* how the economy works? Can the student practice good economics in Nigeria? What does good economic practice consist of? Is good economic practice possible? Are students being trained to practice good economics? Do graduates of economics do good economics? Basic to all these questions is the reality-theory gap. If the gap between theory and reality is so wide that theory is misleading or irrelevant as Keynes and Eskor Toyo claimed, graduates of economics will not know how the economy works and their practice and their doing of economics will not produce either sound output or sound outcomes. Worse still, the graduates' doing and practice of economics particularly in the policy arena may be truly disastrous as Keynes pointed out.

I found it important therefore, to raise and contemplate the questions, convinced that they had "profound effects on the credibility of the *theories* that students learn and assimilate hence, on the *practice of economics* (theorizing, testing, deducing, modelling, sampling, policy analysis and policy implementation). I was aware of the frustration among students, policy makers and non-economics about economics and, the institutionalized "bias against the search for knowledge on how real economies work."[25] I hoped that by raising the questions, students and policy makers will be interested in the way the questions were answered. I expected that they would then channel their frustration fruitfully into acquiring insight into economics as I have done. Also, that philosophy and methodology of economics will become foundational in undergraduate and postgraduate curricular of departments of economics in Nigerian universities.

The Essay had a simple hierarchical schema with the notion of *basicness* in philosophy as foundational. Applying the notion of fundamental or primary, I was convinced that philosophy was basic to methodology and methodology basic to economics. The two premises imply that philosophy is basic to economics. I showed in

[25] For instance, a survey by Colander and Kramer found that only 3% believed that "having a thorough knowledge of economy" was important to success in graduate school compared to more than 50% who believed that excellence in mathematics was the key determinant of success (Klamer & Colander, 1987; quoted in (Hausman, 1992)).

The Essay (1) how philosophy helps to make economic concepts clearer and (2) how philosophy has influenced the ontological approach preferred by orthodox economists and the categories of economics. The concept of philosophy in The Essay was influenced by Earle (1992) and Bertrand Russell's view of philosophy (Russell, 1972).

According to Earle (1992), etymologically speaking, philosophy means "love of wisdom" where wisdom "is used inclusively to cover sustained intellectual inquiry in any area." Earle (1992:3-4) explained further that philosophy is conceptual and its essence, is to attain conceptual mastery by means of *conceptual analysis*.[26] It was immediately obvious to me that "economics concepts like consumer, production, distribution, exchange, value, scarcity, economic problem, choice, free will, price, market, information, perfect market and *homo economicus* or economic man are clear candidates for conceptual analysis." In It was also clear to me that I did not have conceptual mastery of any of these concepts. I therefore, undertook a conceptual analysis of *homo economicus* which I believed to be basic to orthodox economics. The conceptual analysis revealed key metaphysical, epistemological and ethical content of the concept I had hitherto, like most economists, taken for granted.

The following was the conceptual analysis of economic man (*homo economicus*) in terms of necessary and sufficient conditions.

X is an economic man IFF
(a) X has free will
(b) X has perfect knowledge
(c) X is selfish
(d) X prefers pleasure to pain
(e) X chooses independently
(f) X would choose the most preferred option if that option is available[27]

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[26] Before I read Earle, I overestimated the capacity of a Standard English dictionary as a tool for warding off the dangers that Philip Dick (U.S. science fiction writer) alluded to when he wrote the following words in the Introduction to his novel *I Hope I Shall Arrive Soon*. "The basic tool for the manipulation of reality is the manipulation of words. If you can control the meaning of words, you can control the people who must use the words."

[27] The last two necessary conditions are equivalent to saying that man is "an isolated ego, calculating his own advantage" (Earle, 1992:196). This raises the

This conceptual analysis claims that each of the statements is a necessary condition and together; they are sufficient to make X a *homo economicus*. It should be obvious that the conceptual analysis illuminates the concept of economic man better than the phrase rational man. A set of metaphysical questions become obvious: "does X exist?" "can X choose?" and "does X suffer from subjective illusions?". The condition "X has perfect knowledge" means no living human being can be X. Ethical questions also become obvious: "is selfishness good?" and "is it right for X to be an isolated ego, calculating his own advantage"? A methodological issue also arises; if X does not exist, is it appropriate to use X as foundation for theorizing and for generating economic principles *for* societies where X is neither a citizen or leader?

In Bertrand Russell's view, philosophy was "something intermediate between theology and science". He believed that although philosophy shared subject matter with theology; its appeal however, was not to authority but; like science it appeals to human reason. He also established domains for theology, science and philosophy thus:

> All *definite* knowledge – so I should contend – belongs to science; all *dogma* as to what surpasses definite knowledge belongs to theology. But between theology and science there is a No Man's Land, exposed to attack from both sides; this No Man's Land is philosophy" (Russell, 1972)

My views have diverged from Bertrand Russell's position as I would show later. In The Essay however, I inferred the influence of philosophy from economic concepts, methodologies and theories and from the history of economic thought. Some of the philosophical schools and the key questions they attempt to answer are shown in Figure 4. The Figure 4 suggests that (1) epistemology is basic to philosophy of science and (2) philosophy of science is basic to philosophy of social sciences. Two key relationships are also worth noting: "relations between philosophy of science and metaphysics" and relations between philosophy of the social

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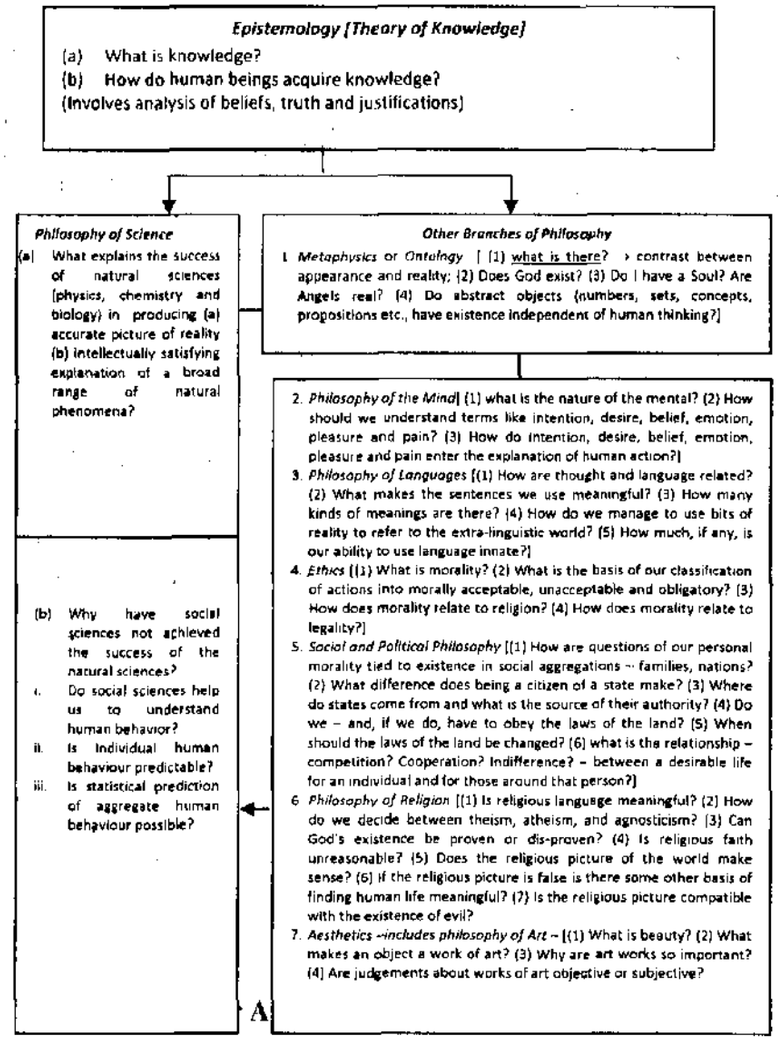
individual-society problems (see Knight, 1935) and ethical foundations for *homo economicus*.

sciences on the one hand, and philosophy of science, ethics, social and political philosophy, philosophy of religion and philosophy of language on the other. What this means is that *philosophy of social science is not independent* of epistemology, metaphysics, philosophy of science, ethics, social and political philosophy, philosophy of religion and philosophy of language.

Two epistemological questions are significant: *can humans possess knowledge* and *what is the source of knowledge*? Knowledge is either know how (skills) or know that (propositional knowledge). It is the later that is subject of philosophical contemplation. The standard view is that *knowledge is justified true belief*. It is therefore possible to believe that one knows when one does not know because what one believes to know may not be true or one may not have justification for believing that one knows. In The Essay I wrote:

> The conceptual analysis of knowledge as justified true belief implies that the Nigerian student, teacher or policy maker who believes that *p* (economic theory) would not have "economic knowledge" regardless of the intensity of belief unless *p* is true and the Nigerian student, teacher and policy maker is justified in believing that *p*. If X (the Nigerian student, teacher or policy maker) says "I know that *p*" and *p* is false, X makes two mistakes: (1) that *p* is true when it is false and (2) overestimates his knowledge. If X has confidence in *p*, X could become dogmatic about *p* and adopt a defensive posture towards evidence indicating that *p* is false. As we shall show, believers in neoclassical theories tend to resist sometimes "violently", assessment that the set of core *p* of their theories is false logically or factually.[28]

[28] Richard Lester in the early 1940s conducted sample studies of firms to test a core neoclassical proposition that firms maximize profits. His results contradicted the proposition eliciting "angry responses (especially from Machlup 1946, 1947; Stigler 1947), partly because everybody knew he was right" (Hausman, 1994:159).



Therefore,

> the Nigerian student, teacher and policy maker who think they know how the Nigerian economy works because they *believe in* neoclassical theory or any other theory open themselves to three mutually re-enforcing errors: (a) confusion of *belief in*. . . for *know that*, (b) the theory is

false, and(c) overestimation of their inventory of knowledge.

The question can humans know is much debated. At one extreme is the view that humans cannot know which immediately raises the question *how does the skeptic know that humans cannot know*? What has therefore dominated the debate is skepticisms about faculties (mind and senses) and skepticism about the ***transcendental reality*** (the intuitive and spiritual knowledge beyond the scope of the empirical and material).

The debate that has influenced orthodox economics is the skepticism about faculties (the mind/senses divide). Indeed, epistemological debate has influenced philosophy science and, the philosophy of the social sciences. In philosophy of sciences two sets of relations have dominated: theory-reality relation and, the conditions for theoretical success. Conceived as a "family resemblance concept" in terms of a body of disciplines that share "many methods, procedures and techniques" (Earle, 1992), the construction of scientific theory is the essence of science while its goals are *explanation of phenomena* and *prediction*.

Two models of explanation have been offered by Hempel (1965). The first model is the *deductive-nomological* in which the statement of what is to be explained is ***deduced*** from ***true statements of initial condition*** and ***laws*** (nominal necessities). Phenomena thus have epistemic explanations hence, it is impossible to give a good explanation if the statements of initial conditions and the laws are false (Hausman 1992:289). In the second model of explanation – *inductive-statistical* – evidence is the basis for belief that an explanation has been offered. Two weaknesses are emphasized. First that it is not epistemic.

Second, that sometimes, a leap of faith is required to believe that an explanation has been offered. Consider the following schema:

All observed Africans are Nigerians

Therefore, all Africans are Nigerians

The statement all Africans are Nigerians is false because the *inductive inference* is based on the belief that the evidence (all observed Africans are Nigerians) is generally true. These types of weaknesses of the inductive-statistical model of explanations are distrusted by "rationalists." While two remedies are being used (making samples representative) and discovering a *nomic regularity* (law) that supports empirical observations, earlier empiricists like David Hume who believed that senses was the source of substantive knowledge argued that explanation had no place in science. Therefore, "instead of A caused B, it should be Property A and property B are empirically correlated." In other words, *empirical causation* or *empirical correlation* should replace causal determinism.

In all major views of science, "prediction is the second element (to explanation or empirical correlation)" though, predictive success varies from science to science. The theory-reality divide was closed if observation and experiments confirm the theory. The "Ravens paradox" however, challenged the view that evidence can confirm a theory.[29]Thus, the confirmation or verification criterion was supplanted in logical positivism by the "falsifiability" criterion which Karl Popper offered as a means of distinguishing science from pseudo-science. Whereas a science has falsifiable predictions a pseudo science does not.

Thomas Khun (1970, 1974) and Imre Lacatos (1970and 1978) shifted focus from the theory-reality divide and testing as the criteria for evaluating theories to a comparison of theories. Thomas Khun's *Theory of Scientific Revolution* challenged Karl Popper's emphasis on falsifiability arguing that in "normal science" scientists do not tests theories; they solve puzzles: "it is just the incompleteness and imperfection of the existing data-theory fit that, at any time, define many of the puzzles that characterize normal science." Further, that if "any and every failure to fit were grounds

[29] Earle's (1994) account of the raven paradox indicates that the logical paradox of the same evidence not supporting two logically equivalent generalizations: "all ravens are black" and "all nonblack things are non ravens". A white cow is both a non-black thing and a non-raven; a white cow thus supports the statement "all nonblack things are non- ravens. However, the existence of white cow does not confirm that all ravens are black. The appearance of a white raven would falsify the statement all ravens are black.

for theory rejection, all theories ought to be rejected at all times" (Kuhn, 1970 quoted in Hausman, 1994:85).

Kuhn used the concepts *paradigm* and *disciplinary matrices* to distinguish classes of theoretical activities. The disciplinary matrices had four sets:

(a). "symbolic generalizations" – fundamental laws held tenaciously by believers and are not easily reversible;
(b). metaphysical and heuristic commitments – standards for accepting answers to questions or solution to puzzles;
(c). values – commitment to honesty, consistency, respect for data, simplicity, plausibility, precision, problem solving, compatibility with other theories; and
(d). exemplars – strong influence of successful practitioners.

Lakatos (1970, 1978) introduced the concept of a *research programe* to refer to a set of theories connected by *heuristics* and a *common theoretical core*. Lakatos's hard core consists of *fundamental laws* and *metaphysical presupposition* a combination of Thomas Khun's symbolic generalization and metaphysical commitments. Lakatos's heuristics are of two classes: negative (rules that forbid those in research programmes from tinkering with the core) and positive (instructions about how to use the hard core)." The two schemas of Kuhn and Lacatos bring out institutional character of science and offer general ideas for categorizing and evaluating the successes of paradigms or research programmes.

Orthodox economists seem to have accepted the epistemic standards that philosophy of science has set. For instance, John Stuart Mills clearly recognized that it was absurd to think that (1) "*mankind (is) occupied solely in acquiring and consuming wealth*" and (2) that all economic operations - wealth accumulation, production, innovation and exchange flow only from a desire to accumulate wealth, yet that was precisely what he did. And what was the justification, "it is the mode in which science must necessarily proceed". Part of his argument on definition and method is as follows.

On definition he wrote:

> What is commonly understood by the term "Political Economy" is not the science of speculative politics, but a branch of that science. It does not treat of the whole of man's nature as modified by the social state, nor of the whole conduct of man in society. *It is concerned with him* and aims at showing what is the course of action into which mankind, living in a state of society, would be impelled, if by that motive, except in the degree in which it is checked by the two perpetual counter-motives (aversion to labour and desire of the present enjoyment of costly indulgences) were absolute ruler of all their actions. (Mills, 1994:52-3).

On economic operations he wrote:

> Under the influence of this desire, it shows mankind accumulating wealth, and employing that wealth in the production of other wealth; sanctioning by mutual agreement the institution of property; establishing laws to prevent individuals from encroaching upon the property of others by force or fraud ; adopting various contrivances for increasing the productiveness of their labour; settling the division of the produce by agreement; under the influence of competition (competition itself being governed by certain laws, which laws are therefore, the ultimate regulators of the division of produce); and employing certain impediments (as money, credit, ..) to facilitate the distribution. (Mills, 1994:52-3).

In defense of the "*absurd view of mankind*" he wrote:

> All these operations, though really the result of the plurality of motives, are considered by Political Economy as flowing solely from the desire of wealth. The science then proceeds to investigate the laws which govern these several operations, under the supposition that man is a being who is determined, by the necessity of his nature, to prefer a greater portion of wealth to a smaller in all cases, without any exception than that constituted by the two counter motives already specified. *Not that any political*

> *economist was ever so absurd as to suppose that mankind are really thus constituted; but it is the mode in which science must necessarily proceed.* (Mills, 1994:53).

William Stanley Jevons (Jevons, 1866) was convinced a theory of the economy "has always of necessity been mathematical in its subject" because the economy is concerned with quantities. Therefore, applying the powerful methods of mathematics will be successful because its "mathematical principles may become formal and certain, while its individual data remain as inexact as ever." Yet, the true theory will source from a non-quantitative root "*the feelings of pleasure and pain*" for a "large part of such feelings arise periodically from the ordinary wants and desires of body or mind, and from the painful exertion we are continually prompted to undergo that we may satisfy our wants." Economics will then be limited to investigations of "the relations of ordinary pleasures and pains" even though he admitted that motives arising from conscience, compassion, or from some moral or religious sources are nearly always present with us, economics should not be concerned with them. Rather, other branches of knowledge should treat them.

Mills used physical laws (centripetal forces and tangential forces and explanation of the movement of the earth) to justify his method[30]; Jevons used mathematics and, Robbins (1935) employed mechanics to specify what should be in economics and what should go to the "box of *ceteris paribus*". According to him,

> In pure Mechanics we explore the implication of the existence of certain given properties of bodies. In pure Economics we examine *the implication of the existence of scarce means with alternative uses*. As we have seen, the assumption of relative valuations is the foundation of all subsequent complications. . . Why the human being

[30] According to him, "the laws of centripetal force and tangential force must have been known before motions of the earth and planets could be explained, or may have been predicted". Therefore, political economists, "wish through their causes, to obtain the power of either predicting or controlling the effects" they must separately investigate economic phenomena even if the effects "depends on concurrence of causes" (Mills, 1936 in Hausman, 1994:53).

> attaches particular values in this sense to particular things is a question which we do not discuss. That is quite properly for psychologists or perhaps even physiologists All that we need assume as economists is the obvious fact different that possibilities offer different incentives, and that these incentives can be arranged in their order of intensity.

The desires of Mills, Jevons and Robbins to make economies social copies of natural sciences, raises a question that philosophers of social sciences have contemplated: "what kind of a science can economics be?" One of the challenges against social sciences is the "free will question". It is argued that the free will problem limits the chances of economics and related disciplines from producing causally deterministic explanations like the physical sciences. It is suggested that the free will problem makes it difficult for social science to be more than a pseudo science. The argument is: if humans have free will, humans have options when they are making a choice at time *t*. The options for the disciplines in the social sciences are for them to deny that free will exists or reconcile choice (free will) with causal determinism. From the conceptual analysis of *homo economicus*, it is obvious that economics have not denied free will. For choice is basic to theories of economic actors, theories of economic markets and, welfare economics. To deny free will is to bring down the house that Mills, Jevons, Leon Walras, Robbins and all those economics of the Lausanne and Cambridge schools built.

The Essay reviewed the methodologies that economics have used to formulate theories: logical deduction; empiricism; logical positivism and the axiomatic method. The review highlighted two main points. First, there is no agreement among economists on methodology or on the purpose of economics or on its domains. Two, the fact that Friedman's principle of unreality (or *F-Twist* as Paul Samuelson referred to it) has dominated economic theorizing from the 1950s was in spite of the fatal logical flaws and, its impracticability in the conclusive proof of the validity of the claims of orthodox theory.

Herbert Simons (1963) follows up on the critique of the Friedman's *F-Twist* (as Samuelson labeled it) or "principle of unreality" (as Simons called) by Professor Nagel and Samuelson. Both focused on the logical fallacy of the F-Twist. For example, with mounting evidence that Y is false, the truth of Z cannot validate

Y. Simons used the theory of economic actors to derive the two basic premises: (1) X – "business men desire to maximize profit" and (2) Y – "businessmen can and do make the calculations that identify the profit maximizing course of action". From the theory of markets, he derived the statement of the claim: Z – "prices and quantities are observed at levels that maximize the profits of firms in the market". In a theoretical system comprising X, Y and Z, the logical implication is that "X and Y are necessary for Z". Therefore, Z cannot be true if either X or Y is false. With mounting evidence indicating that Y was false, Z could not validate Y. However, Simons points to a more serious flaw: Z could not be tested. His argument was:

> No one has in fact observed whether the actual positions of business firms are not the profit-maximizing ones; nor has anyone proposed a method of testing this proposition by direct observation. I cannot imagine what such a test would be, since the tester would be as incapable of discovering what the optimal position actually is. . . (especially since) we cannot identify profit maximizers.

The Essay also observed that many economists that were proudly building elegant mathematical models or at the technical frontiers were happily ignorant about the metaphysical, epistemological, ethical and social and political philosophical roots of economics or those they were committing themselves to through their models and estimations. As economists get lost in mathematical and technical elegance, national and global financial and economic crisis have become more frequent, more contagious, more costly and more persistent. In developing countries, orthodox theories and practices thrive in teaching, in research and in policy as "orthodox development economics" helps sovereign creditors and their multilateral agents and local collaborators to design "development finance products" that generate payoffs that are increasingly biased against the recipient countries of development finance as we showed in (Garba, 2003) and (Garba, 2005). Table 1 shows some of the products, the theoretical roots and their costs.

> At the end of The Essay I argued that:
> Notwithstanding the influence of equilibrium theory and its resilience, economics remains a contested terrain and the contests remain rooted in philosophical and methodological discord.

I then drew three conclusions from my interpretation of the evolution of the economics and its underlying philosophical and methodological discords. First, that "methodological convergence in economics may neither be feasible nor desirable". Second, the future of economics may lie in greater consensus on methodological pluralism and shifts in intellectual targets from natural to social laws. Third, that "the performance of the economy would be more decisive in passing judgements on theories and theorizing procedures".

Table 1: Record of Development Economics

Period	Dominant Development View	Source of Knowledge	Who paid or pays the cost?
1950s and 1960s	Correcting market failure and engineering growth	Neoclassical theory, welfare economics, Harrod Domar growth model, Vicious cycle of poverty models, etc and mistrust of markets	Population in developing countries
1970s	Getting prices right	Neoclassical theory and mistrust of the state	Population in developing countries
1980s	Getting policies right	Neoclassical theory and mistrust of state	Population in developing countries
1990s	Getting institutions right	New Political Economy, Neoclassical theory and mistrust of state	Population in developing countries

Source: Garba (2003)

Phase 3: The Spiritual Phase

This phase of my life was influenced by my salvation experience and the resulting transformation in the way I see and understand human existence and the purpose of existence. Doubts about secularism gradually took root as I began to read about and reflect on the history of economic thought and accounts of world history particularly, the transitions of civilizations - Summerian, Egyptian, Nubian, Greece, Chinese, Dravidian, Christian, Islamic, Aksum and Western (particularly, its transitions from theocracy to secularism). I found the deep seated prejudice and the network of asymmetries and dis-advantages institutionalized globally by Western civilization unacceptable. The policy and institutional studies, the gender studies and the globalization and conflict studies all convinced me that there was something fundamentally wrong

with the system of meaning that shaped secularism and the intellectual enterprise it bred.

The Age of Enlightenment and the Age of Reason were pivotal in the transition to secularism. Enlightenment thinkers had *faith* in human reason to engineer sustained human progress (knowledge, technical and ethical) and faith in science. In addition, they gave greater weight to worldly happiness. Success in science in the 17th and 18th Century gave man self-confidence to assert as Kant did that "*Sapere Aude!* [Dare to know!] Have the courage to use your own intelligence! is therefore the motto of the enlightenment" (Kant, 1949 and Microsoft Encarta, 2009). However, science tends to restrict human cognition to what is seen and observed. Yet, there are probably an infinite set of things, phenomena and processes that are not known to the human mind and probably much less to the human eye and experiences. How then can we be perfectly sure that we do not need a transcendental authority to know and to use what we know wisely?

When I reviewed what I know (λ) relative to what I do not know (∞) it was clear to me that what I know as a ratio of what I do not know (λ/∞) is approximately zero. I clearly, do not know enough to deny transcendental reality. On the contrary I have the phenomenological experiences that fully convinced me of transcendental reality. A belief in transcendental reality influences me to see things differently, to reason differently and to have a perspective about knowledge, wisdom and understanding that I did not have.[31] More than ever before, I am convinced that human knowledge is too limited and too imperfect to lead humanity to virtuous cognitive enterprises and virtuous existence at the level of individuals, families, households, social groups, nations and globally. Just look around you as you move around; as you listen to the radio ad as you watch the television and as you navigate the World Wide Web. Are you satisfied with what you see, hear, read, know and understand? The simple truth is; I am not.

At this phase in my life, I no longer accept as valid, Bertrand Russell's views that ranks sciences and philosophy above the

[31]A preacher once said, "the man with the experience wins over the man with the argument" (Dr Akpami of the Christian Teaching Center at a Revival in Calvary Baptist Church).

spiritual. Russell's views were obviously biased by his lack of faith in institutionalized religion. The fact that cognitive enterprises are influenced by biases and the high likelihood of *unknown unknowns*[32] means that it is *reasonable* and *wise* to interrogate all products of human thought.[33]

The high likelihood of cognitive biases and unknown unknowns means that it will be dangerous to dogmatically accept enlightenment ideas and the boundaries that secularists have imposed on human cognitive experiences. It is not wise for one to deceive oneself into believing that one is capable of perfect knowledge as orthodox economics have assumed for *homo economics* (a human creation). The human minds that created *homo economicus* as the analytic for economics and logically erected a super structure on it are imperfect. How then, can the product of their minds be perfect? If it is obvious that their thoughts are imperfect why then should we be expected to hold on tenaciously to orthodox economics for as long as economists have despite the (1) valid methodological criticisms by generations of economists and social scientists; (2) the works of cognitive psychologists and statisticians that have provided counter examples to the predictions of orthodox economists; (3) the fact economic history has shown that financial and economic crisis have every deepening of the policy recommendations of orthodox economics and (4) the failure to solve puzzles and paradoxes such as simultaneous failures of governments and markets; mass poverty; failure of economies to provide full employment; consistent volatilities in the global economy/business cycles; growth in poverty; upward shifts in unemployment; globalized growth in asymmetries in participation and in payoffs; and so on.

Economics is at a crossroads. The current global financial and economic crisis has been characterized by huge losses by financial institutions and the demise of financial institutions. Furthermore, there have been substantial bailout costs that triggered sovereign debt crisis in the Euro-zone; growing spread of policy

[32] Unknown unknown refers to events/things that people do not know that they do not know.

[33] The old FASS taught us to interrogate all products of human reason and observations. Unfortunately, the rigorously critical tradition has at best weakened.

capture (Greece, Portugal, Ireland, Spain, etc); disconnect between finance and the real economy globally and low economic growth in major economies. The crisis has also resulted in record levels of aggregate and youth unemployment; high costs of government bailouts and disproportionate costs of government response to the global financial and economic crisis and so on. These expanding set of concrete economic problems, the deepening and spread of social and political problems across nations of the world and the spread of violent conflict and insecurity globally call for a deep rethinking of national and global social orders.

Orthodox economics has been the foundation of national and global social orders for at least two centuries. In these two centuries, there has been the worst incidence of wars[34], exploitation (colonial and post-colonial) and global economic and financial crisis and their associated economic, social and political consequences. It is also true that human beings have made many scientific, technological and economic advances that have improved their material conditions. The question is, has material improvement translated to a more humane, more harmonious and more civilized world where virtues are the essence of human choices, human action and human relations? I doubt that. I believe that the type of economics that has shaped the world for much of the last two centuries is, at least, one of the important factors that influenced the path of the world to the current state of globalized chaos and discontent. If I am right, then we have to have a serious debate about the economics that should guide the future. Wisdom teaches that it is foolish to do the same thing several times over yet, expect different results.

An Argument for a New Foundation

The Foundation and its Fatal Flaws

Knowing the structure of economics helps to identify the real foundational problems. The literature offers a diversity of perspectives on the structure of economics. Table 2 summarizes three of such perspectives. The views of Latsis and Weintraub are similar: economics makes *ontological commitments* (positivism and equilibrium analysis); and proceeds from *metaphysical and ethical*

[34] Two world wars (World War I and World War II); the Arab-Israeli Wars; the Korean War; Vietnam War; the wars of political liberation in Africa, Asia and Latin America; the Iraq-Iran wars; the Balkan wars; the Afghanistan Wars; the Iraq wars; China-India-Pakistan wars; and many civil wars and insurrections including those currently on-going: Syria; Somalia; Mali; Nigeria; and so on.

assumptions about the *nature* of economic actors, their environment, economic phenomena and; the *nature* of markets. Hausman's structure offers more details especially about the set of assumptions, about the commitment to scientific goals of explanation and predictions and the employment of *comparative statics* to make predictions. In addition, he presented four theses which he believed "define the global strategy and structure of economics" and they are:

(a) "Economics is defined in terms of causal factors with which it is concerned, not in terms of a domain."
(b) "Economics has a distinct domain, in which causal actors predominate."
(c) The "laws" of the predominating causal factors are already reasonably known
(d) Thus Economic theory provides a unified, complete but inexact account of its domain.

The theses had two authorities: Mills (1836) and Robbins (1935). To understand the theses, I use four questions as guides. First, what is the domain of economics? Second, what causal factors predominate in the domain of economics? Third, which laws are assumed to be reasonably known? Four, what makes economics separate, unified, complete but inexact?

To Mills, the domain of political economy was limited to "the phenomena of a social state as takes place in consequences of the pursuit of wealth". Such phenomena included wealth accumulation, production, innovation and exchange that flow only from a desire to accumulate wealth. It excludes all human passion or motive except aversion to labour and the "desire for present enjoyment of costly indulgencies". If we include Jevons as an authority, then we must expand Mills' domain to include all desires arising from "the feelings of pleasure and pain" but exclude, all other motives for human actions: conscience, compassion, moral or religious motives. Robbins rooted his concept of economic phenomena on what he claimed to be four characteristics of human existence: (1) ends are various; (2) time and means for achieving them are limited – "life is short. Nature is niggardly"; (3) time and resources have alternative applications and (4) ends have different importance. He argued therefore,

> But when time *and* the means for achieving the ends are limited and capable of alternative application, *and* the

> ends are capable of being distinguished in order of importance, then behaviour necessarily assumes the form of choice. Every act, which involves time and scarce means for the achievement of one end, involves the relinquishment of their use for the achievement of another. It has an economic aspect. (Robbins, 1935, reprinted in Hausman, 1994:84).

Table 2: Three Views of the Structure of Economics

Economist	Core of Orthodox Economics	Fundamental premises
Spiro Latsis (Latsis, 1976)	1. Decision makers have correct knowledge of the relevant features of their economic situations. 2. Decision makers prefer the best available alternative given their knowledge of the situation and of the means at their disposal 3. Given (1) and (2) situations generate their internal "logic" and decision-makers act appropriately to the logic of their situations 4. Economic units and structures display stable, coordinated behaviour.	• Economic agents have perfect information • Economic agents maximize utility (consumers) and maximize profit (producers) • Equilibrium is the norm.
E. Roy Weintraub (Weintraub, 1985)	1. There exist economic agents 2. Agents have preferences over outcomes 3. Agents independently optimize subject to constraints 4. Choices are made in interrelated markets 5. Agents have full relevant information 6. Observable economic outcomes are coordinated, so they must be discussed with reference to equilibrium states.	• 1,2, 3, 5 imply that agents are rational • 4 implies that markets are interdependent • 6 imply that equilibrium is the norm
Hausman (1992)	1. Laws of choice theory and heuristics (perfect information, continuity, existence of markets, perfect competition, etc), assumptions about institutional, epistemic or physical conditions. 2. Assumptions are supposed to be true or not essential. 3. Partial or general equilibrium 4. Comparative static analysis 5. Definition of rationality 6. Equilibrium theory provides the "positive" foundation for the credibility of the claim that perfect competition is morally a good thing 7. Equilibrium model shapes the whole theoretical enterprise.	• General description of the salient features of the orthodox theoretical enterprise • 1,7 specifies the key assumptions • 3 and 4 specify types of analysis • 6 and 7 specifies that equilibrium is the norm

Source: Organized from Hausman (1992:86-90)

The domains specified for economics, predetermine the dominant causal forces of interest. The causal relations are *desire-action* relations (Mills, 1836 and Jevons, 1866) and *means-ends* relations (Robbins, 1935). The causal relations are anchored in what were assumed to be fundamental laws: "a greater gain is better than a smaller" (Mills, 1843, 6.9.3 quoted in Hausman, 1992:93) or "individuals can arrange their preferences in an order and in fact do so" (Robbins, 1935:78; quoted in Hausman, 1992:93). To appreciate whether they are indeed fundamental laws or just hypothesis from which Mills and Robbins thought, we consider the "*axiomatized*" version of the theory.

The so called "fundamental laws" have been formalized into axioms of preferences, axioms of utility maximization, axioms of profit maximization and axioms of choice sets (consumption set and production set) that *illuminate* the nature of man in orthodox economics. The standard axioms of preference are the axioms of *completeness*, *transitivity*, *continuity*, *strict monotonicity* and *convexity*.

Let us clarify what these abstract concepts mean and the nature of man they assert. Completeness and transitivity are mathematical properties of binary relations while continuity and convexity are mathematical properties of functions and sets. The axiom of "strict monotonicity" is the formalization of the rational hedonism of Mills and Jevons. Its mathematical equivalent is an increasing utility function.

What the axioms mean in economics is more important than what they mean in mathematics because mathematics is to economics, a tool of analysis. In Mills, Jevons and Robbins economic domains and the causal relations specific to it, the core consisted of the nature of the economic phenomena, the nature of man and the causal relations of interest. Therefore, an axiom must be first understood in terms of the core. The axioms of completeness and transitivity and "strict monotonicity" endow man with *ability to compare all alternatives* (completeness); *ability to compare consistently* (transitivity) and *formalize man as a rational hedonist* (strict monotonicity). The axiom of consistency ensures that *a consumer does not suddenly reverse his preferences* while the axiom of convexity ensures that the desired solution is an interior one to represent *man's preference for variety*.

All the axioms put together, expose the primary goal of the theoretician, which is to arrive at predetermined answers. The answers being (1) to show that real valued utility functions that represent specified preferences exist; (2) to use the real valued utility functions to derive goal equilibrium for the consumer and (3) to apply comparative analysis to the goal equilibrium to derive demand functions and demand correspondences. The axioms of preference produce *increasing utility functions* which joined to the axiom of utility maximization and the budget set produces the desired consumer optimum. Comparative analysis is applied to consumer optimum producing the desired demand function or correspondence.

A few points are appropriate at this point. First, metaphysically, economic man (*homo economicus*) does not exist: no human being that exists knows all the alternatives for any given choice situation or is able to rank all alternatives completely and consistently. Herbert Simons enlightened economists and their followers that the fundamental issue is not that humans do not have perfect knowledge but that *humans cannot have perfect knowledge*.[35] Second, real people have *intrinsic motivation* as well as *extrinsic motivation*. For some, the intrinsic dominates while for others, the extrinsic dominates. Third, social scientists have powers to manipulate and to trigger behaviour that fulfill their prophecies. Thus even if human beings have become more selfish, there is a likelihood that the influence of economics and its maxim - *greed is good for self and society* – has contributed to institutionalizing in social orders at all levels of social formation the rationality of materialism, selfishness, greed, hedonism and permissiveness.

The axiom of transitivity of human preferences does not apply to all theoretical orderings or, to real choices which tend to be dynamic.[36] The reality-abstract divide also suggests that preferences

[35] The human brain, like a hard drive, has limited processing capacity. Hence, it cannot process all the information required to have perfect knowledge. I believe everyone from their personal experience can relate to Herbert Simons point. Also, given that many choices are strategic, knowing all alternatives mean knowing all the strategies of other economic agents and, knowing the implications of all possible solutions.

[36] Theoretically, the lexicographic ordering is not continuous or transitive. In reality given a choice between Coca Cola, Pepsi Cola and Fanta, transitivity requires that if an economic actor prefers Coca Cola to Pepsi Cola and, Pepsi Cola

are not complete, consistent or convex. Thus even if human preferences are strictly monotonic, a real-valued utility function that represents the preferences will not exist. And if a real-valued utility function that represents preferences does not exist, then goal equilibrium and market equilibriums consistent with preferences will not exist. This is a *fatal consequence* because the axiomatic approach defended and extensively applied by Debreu and many contributors to modern microeconomics sought to "provide a more secure foundation on which the construction of economics can proceed"(Debreu, 1977). For "the complete specification of assumptions; the exact statement of conclusions, and the riguor of the deduction of an axiomatized study", they exposed the fatal foundations of economics.

The axioms of production and of profit maximization also *illuminate* the nature of production and partly, the nature of the producer as a *homo economicus*. The key axioms of production are (1) production set is non-empty, closed and convex; (2) no production is possible; (3) nothing can be produced from nothing; (4) production is not reversible and (5) and wastes are freely disposable. Assumptions two, three and four make good sense. Part of axiom one also makes some sense: if a resource is available, and if just transformation is possible, then the choice set is non-empty. However, following Robbins, economic phenomena will not exist if there is only one option (recall the conditions for existence include existence of a resource, alternatives and different valuation of alternatives). However, the assumption of convexity does not accord with realities of technical progress which is better represented by concave production sets. A good example is the information and tele-communication (ICT) industry; therewith, technical progress advances so frequently that declining costs and prices is the norm.

Orthodox economists *know* that concave production sets fatally damages equilibrium analysis since it is not compatible with the existence of an optimum. Yet, in a tenacious drive to predetermined theoretical ends, they insist that production sets are convex and make it a core assumption. Pierro Straffa (1927), which

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to Fanta. the agent must prefer Coca Cola to Fanta. In a dynamic setting, preferences may not be static. An individual who prefers exhibited at another time, prefers Coca Cola to Pepsi Cola at time *t*and, Pepsi Cola to Fanta at time *t+1* may prefer Fanta to Coca Cola at time *t+2*.

Professor Bade Onimode – a passionate critic of orthodox economics – made us read in graduate school left an impression on me. For he argued, rightly I believe, that orthodox production theory can stand only if the nature of production is decreasing returns to scale (Straffa, 1926). Substitute the axiom of decreasing returns to scale with constant returns to scale in producer theory and orthodox production theory runs into a problem: either (1) there is no equilibrium or (2) there are "multiple equilibria". None of the two options is good for orthodox economics because it disables the method of comparative statics from generating supply functions. The fatal condition however, is that in the case of *increasing returns to scale*, equilibrium does not exist. Obviously, if equilibrium does not exist, no comparative statics could be conducted; no comparative static analysis implies that no supply function could be derived; and without a supply function; the second leg of orthodox economics cannot exist!

Assumption five, that waste is freely disposable or the axiom of free disposal as it is elegantly referred to was necessary is some proof of existence of general equilibrium (Debreu, 1995). However, the fact that some orthodox economists went so far as to impose the axiom of free disposal to achieve theoretical goals raise fundamental issues. First, because production involves a set of processes (material, monetary, social and political), *the assumption of free disposal potentially endangers the material balance* of the world for it suggests that profit maximizing agents need to freely dispose of production wastes to achieve their goals. It is also formalized in the assumption of zero-externalities required in deriving aggregate production set and aggregate consumption sets which are used to establish existence of general equilibrium. The effects of these types of reasoning on the global environment have become visible in the environmental damages and changes in weather patterns. In Nigeria, it is most visible in the Niger Delta where the cumulative effects of a convergence of motives (private and public rent maximization) are destroying the environment (physical and social) at great costs to human lives.

Second, the assumption of free disposal raises some of the individual-society issues that Frank Knight (1935 reproduced in Hausman, 1994) highlighted. The relevant issue here is; should society accept individual ends and means as the main objectives of social policy even when they conflict with social ends and means? It is appropriate to accept individual ends and means as the goal of social policy if they were compatible with social means and ends. Because economic power and information are not evenly distributed,

those with strategic advantages achieve their end at the expense of society and the vulnerable parts of society. As the sub-prime crisis has revealed, both the society and individuals are at risk when states fail to enforce impartial rules that keep economic games from harming society and individuals. In the case of Nigeria, we showed in Garba and Garba (2001) that the failure of social policy complemented a failure of market to cause high and sustained social costs including environmental damages.[37]

The *nature* of markets in orthodox theory is a perfect market. However, a perfect market cannot exist if economic agents are not *homo economicus*, this is also the case if consumer optimum, demand function, producer optimum and supply functions do not exist. The reality is that (1) imperfect markets (monopolies, duopolies, oligopolies and bilateral monopolies) are the norm; (2) the natural tendencies of markets left unchecked is towards less competition and (3) the nature of real markets are continually changing. The first two imply that it is not true that consumers and producers are price takers and second, that markets produce outcomes that are socially optimal. Rather, because asymmetries in economic power and in information are the norm, real market outcomes tend to favour those who possess strategic advantages (market power and the best information). It is not therefore, valid to assert that markets promote efficiency. At best, the assertion is misleading and at worse, dishonest.[38]

It is also not valid to limit markets and economic phenomena to allocation problems given the work of the Austrian school (Thomsen, 1992) that markets are not static allocative devises but dynamic discovery and creative processes. Further, that the entrepreneur therefore, is the appropriate economic agent on the supply-side and not the abstract producer/firm. The cognitive control that orthodoxy continues to have over economics has kept

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[37] It is also worth noting as Knight (1935) pointed out that *individual ends and individual means are created historically* in the social process hence, are influenced by social policy.

[38] Theoretically, efficiency requires at least two conditions that (1) *homo economicus* choosing the best alternatives and (2) exchange takes place in perfect markets. Since *homo economicus* hence, perfect markets do not exist, market generated social optimum is a fallacy. Empirically, markets are heterogeneous hence they deliver different degrees of efficiency and, equity. This is why generalizing about market efficiency is dangerous. It is dishonest to argue as some do that the mere existence of markets, even in war situations, is a proof of the validity of orthodox theory.

disequilibrium analysis, the entrepreneur and entrepreneurship out of mainstream economics.

The changes that have taken place in markets make a mockery of orthodox theory which can be likened to *an old antiquated stationary vehicle* overtaken by a fast moving Ferrari sports car. This can be illustrated with the evolution of the mortgage market which is shown in Figure 5 below. The figure shows two market models: the traditional mortgage market model and the sub-prime model. In the traditional model, there are just two players: the home buyer (borrower) and the bank (lender). The bank would normally evaluate the house and the borrower to assess the credit risk, size of loan and payment schedules. When an agreement is reached, the bank will grant the mortgage and the borrower would pay the bank according to the schedule of payments. The size of the mortgage market is limited by the deposits of the bank and monetary policy.

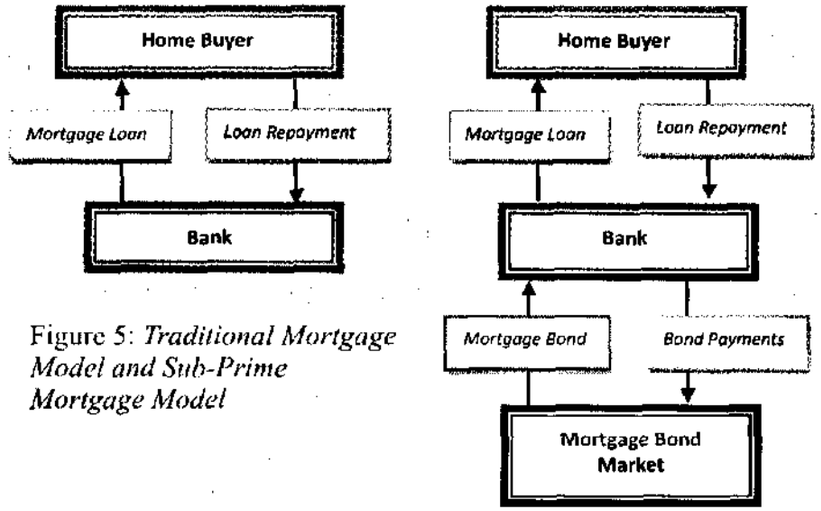


Figure 5: *Traditional Mortgage Model and Sub-Prime Mortgage Model*

To expand the mortgage market and earn more profit, the sub-prime model was developed. In the *sub-prime model*, a new market for mortgage bond is created and three new players (home appraiser, mortgage broker and rating agencies) join the mortgage game as part *a new middle*. Instead of the two-way transaction in the traditional model, there is now a four-way transaction: (1) bank sells mortgage bonds and receives payments; (2) bank offers loans to

home buyers assessed by the new middle players (home appraiser and mortgage brokers); (3) the home buyer pays banks through mortgage brokers and (4) bank pays holders of its bonds. The new mortgage bond market stimulates growth in funds available for lending by banks to home buyers[39]. The growth in funds combines with a built-in incentive[40] for the new middle players to sell more mortgages and with greed to increase the risk of financial crisis. In a liberal financial policy environment, the combination of growth in funds, built-in incentive and greed makes a crisis inevitable. With Collateralized Debt Obligations (CDOs), derivatives and future markets; instantaneous financial transactions and complex pricing models; *orthodox economics is out of its depths even as a science of rational greed.*

Finally, the idea that economics is a separate, unified, complete but inexact discipline does not resolve the fundamental flaws in economics. First, the separation of spheres of economics in Mills was not absolute. Mills recognized the need to make "proper allowances for the effects of any impulses of a different description, which can be shown to interfere with the results in any particular case" (Mills, 1836 quoted from Hausman, 1994:54). Mills was convinced for instance, that the basic model must make necessary adjustments to interpolate the principle of population into political economy. Therefore, *Hausman's conclusion that economics should be limited to studying greed using a single unified theory cannot help economics or economists justify its continuing relevance as a viable discipline.* Similarly, to limit progress in economics to only what can be shown to flow "from equilibrium theory and generalizations about beliefs, preferences, and constraints" exemplifies the type of cognitive control that orthodox economics has had on generations of economists and frustrated every effort to improve economic science.

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[39] The loan book now consists of deposits and revenue raised from sale of bonds.
[40] This is because commissions are tied to loan size which is not only tied to eligibility but also, value of houses. The incentive thus exists for brokers to facilitate lending to sub-prime borrowers and for home appraisers to over-value houses.

The Argument

The argument for a new foundation is multi-dimensional yet, organic. The dimensions include purpose, epistemology, metaphysical, ethical, exemplars and structure. The purpose argument shapes the epistemological, metaphysical, ethical and structural arguments. I start with purpose as foundational because I am convinced that every person involved in a cognitive enterprise must ask and honestly answer the question: what is the purpose of what I am doing? For it is purpose that helps a human being to be sure that what he or she is doing has worth or value that justifies the effort. Why does economics exist? What is the value of all the economic books, monographs and papers that we have all written? Is it just for promotion? Is it for winning prizes? Is it to make economics a science so that we can be admitted into the club of scientist? Even this lecture faces the purpose question; what is the reason for it? Without a purpose, a thing has no worth; doing it is meaningless. If the reason for doing a thing is also morally unsound and imprudent, a transformation is required to make it meaningful.

Purpose

I am convinced that the purpose of orthodox economics as *a study of rational greed* needs a re-examination because it makes economics truly dismal[41] to all but the greedy. Which other "scientific enterprise", paradigm/disciplinary matrices, research programme or field of study will limit itself to a study of greedy motives or intentions? This re-examination is even more pertinent when (1) the motives and intentions of human beings are not limited to greed; (2) time is short and resources are limited hence should not be used immorally and unwisely; (3) there is a great likelihood that greed will destroy the greedy (at least morally) and undermine social cohesion; and (4) the idolization of greed is more likely to make more people including economists greedy and self-loving. The trade-offs and opportunity costs of greed are of such magnitude as to

[41]**Thomas Carlyle** (1795 - 1881) is credited with using the word dismal in reference to Malthusian theory of population and the phrase dismal science to describe political economy in his tract *Occasional Discourse on the Negro Question* in which he advocated slavery. The context for the use of the word dismal is obviously different.

warrant a re-examination of greed. Besides, how can society trust greedy and self-loving economists to objectively think about and produce ideas and advice that serve the common good since rationality of greed demands that the economist places his interests above those of society?

The ones who *most* benefit from a cognitive enterprise devoted to analysis of rational greed are, the greedy economic actors that possess or acquire strategic advantages at individual, national and global levels. An over-riding interest on the rationality of greed therefore, makes economics a tool for promoting greed and, the interests of the greedy. I found it strange, looking back at graduate school the excitement in orthodoxy with hedonistic functions. I contrasted that enthusiasm with the words of the King Solomon famed for his wisdom:

> Whoever loves money will never be satisfied with money. Whoever loves wealth will never be satisfied with more income. Even this is pointless (Ecclesiastes 5:10).

Then I see in the axiom of *strict monotonicity* in consumer theory, a blissful formalization of a *curse of non-contentment* into the core of economics. And I wondered and still wonder; how could economists not know that a life that lacks contentment about material possession is *a miserable life of endless wanting*? The greater tragedy is that without this curse, the fundamental pillars of orthodoxy (demand and supply) crumbles.[42] Orthodox theory needs the curse of non-contentment to stand! The question is can a bad tree bring up good fruit?

The idea that orthodox economics is an intellectual enterprise that serves the interests of greedy and hedonistic

[42] First, the proof of the existence of real valued ordinal utility function that represents binary relation "at least as good as" requires complete, transitive, continuous and strictly monotonic (the curse) preferences. Without strict monotonicity, the proof fails and economics loses utility functions and indifference maps which are key devices for analysis of consumer equilibrium and for generating demand functions. Walras' law that total expenditure equals total sales which is used to show that at equilibrium excess demand is less than or equal to zero and prices greater than or equal to zero depends on the axiom of strict convexity or the *curse of non-contentment*.

capitalists is well established in Marxist and radical literature. Leading economists in Nigeria such as Eskor Toyo (Toyo, 2001), Bade Onimode (Onimode, 1995) and Mike Kwanashie (Kwanashie, 2007) have consistently argued that orthodox economics serves the interests of capitalists. Economic history of the last century strongly supports the thesis that *economics serves the interests of the rich people and nations against poor people and disadvantaged nations.* For it was *orthodox economics that provided the intellectual justification for the thesis that income inequality is good for growth*: the rich save, invest and generate growth; the poor consume, do not save, hence retard growth. It was also orthodox economists that provided the intellectual support for the global industry of development finance: vicious cycle hypothesis; the gap models; big push; balanced growth; stages of growth etc. When inequalities began to be observed in the developing economies; the inverted-U hypothesis was put forward: *in the early stage of growth inequality rises, peaks as growth progresses before declining.* The message is that inequality is the price of growth. Therefore, put up with it and hope for when you grow enough for it to decline. This idea ran counter to Keynes *General Theory* which disproved the thesis that growth depended on savings. Yet, orthodoxy held tenaciously to the efficiency-equity trade-off.

It was orthodox economics/economists that offered intellectual foundations for all the phases of financial products invented by the key players in the development finance industry (see Table 1). These include the idea that developing countries need foreign loans to grow because of the vicious cycle of poverty and need to get prices right. Developing countries also need to get policies right and implement deflationary policies to restore growth; they need states; need poverty strategies and should borrow up to some dubious thresholds.

The role of orthodox economics in precipitating and sustaining economic and financial crisis is implicit in Keynes *General Theory*. Indeed President D. D. Roosevelt had to discard the advice of orthodox economists to design and implement the "New Deal" which helped the United States recover from the Great Depression. His defiance was rooted in his belief that economic laws were made by men not by nature and, he could not place the ideas of men above the responsibility to do the right thing while people were

dying and the nation was sinking into despair. In his first inaugural address on March 4, 1933, President Roosevelt explained his core beliefs thus:

> *Happiness lies not in the mere possession of money*; it lies in the joy of achievement, in the thrill of creative effort. *The joy and moral stimulation of work no longer must be forgotten in the mad chase of evanescent profits.* These dark days will be worth all they cost us if they teach us that our true destiny is not to be ministered unto but to minister to ourselves and to our fellow men. *Recognition of the falsity of material wealth as the standard of success goes hand in hand with the abandonment of the false belief that public office and high political position are to be valued only by the standards of pride of place and personal profit*; and there must be an end to a conduct in banking and in business which too often has given to a sacred trust the likeness of callous and selfish wrongdoing. Small wonder that confidence languishes, for it thrives only on honesty, on honour, on the sacredness of obligations, on faithful protection, on unselfish performance; without them it cannot live.[9] (The italics are for emphasis)

More recently, President Bush and President Obama ignored the prating of orthodox economists to bail out banks and to stimulate their economies out of the hole that unbridled liberalism had plunged it. Indeed, all who helped to impose deflationary policies in Africa, Latin America and South Asia in the 1980s and in Greece, Ireland, Portugal and Spain in the second decade of the 21st Century acted contrary to orthodox prescriptions in 2007-08. We have documented in some of the globalization and conflict studies how orthodox ideas endanger global financial and economic stability (Garba and Garba, 2001, 2004; Garba, 2005; Garba, Usman and Sanusi, 2008) hence, global wellbeing, peace and security.

Clearly, the purpose of economics is not compatible with stable social orders at national and at global levels. I do not deny the material progress that humanity has witnessed in the last two centuries. The point for me is, at what cost in human lives and

misery?[43] Along the business cycles – recovery, boom, recession and depression – who gains and who loses? Are wages, prices, returns equilibrating? More importantly, does life consist of material possessions? Do material possessions give us peace, virtues, love, faith and hope that makes life worth living and which build strong bonds of relations and social cohesiveness?

Epistemological Commitments

The flaws in the epistemological commitment of economics to positivism are already well documented in Garba (2003) and the references. It is clear in Mills (1836; reproduced in Hausman, 1994) that a desire to make economics a science was why Mills believed that thinking from hypothesis was the best way and why he created in his mind, an economic realm for studying the passion for wealth accumulation even when he believed it was absurd to think that way. It is also clear that Bentham's "felicity calculations" influenced Jevons to believe that the true science of political economy flow from emotions of "pleasure and pain".

In the time since Mills and Jevons, things have changed and so has what we know. We now know for instance, that economic science cannot be limited to thinking from hypothesis and that the emotions of pleasure and pain are not measurable and so could not be formalized as Jevons believed. In addition, Thomas Kuhn's *Theory of Scientific Revolutions* in its revelation that sciences solve puzzles not test theories, has made puzzle and problem solving the essence of a science. Hence, if economists want their discipline to be a true science, they must solve puzzles; and the global financial and economic crisis has thrown up many problems that need urgent solutions.

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[43]How many people had to be slaves, how many had to die crossing the Atlantic, in slavery and in attempts to escape from slavery to build the US? How many are sweating right now in sweatshops, in slavery and in slave-like production processes to generate profit for greedy capitalists? How many have lost their homes and jobs and dignity as a result of liberal policies and transfer of business cycle costs to disadvantaged groups? Before we celebrate the material progress let us adjust for the human and social costs. Also, we should adjust for the progressive loss of value for humans either through willful destruction of the environment or through social policy that transfer wealth disproportionately to the rich and compel many to dismal existence.

Though this period of great economic instabilities offers opportunities for frontier extending work, economists cannot solve the problems unless they free themselves from the cognitive bondage of orthodoxy. For I am convinced as Keynes was, that success in economics as a cognitive enterprise requires economists to constantly correct their judgements of economists "by an intimate and messy acquaintance with the facts to which (economic) models have to be applied." Herbert Simons made a similar case in his suggestions of a "principle of continuity of approximations" as a replacement for Friedman's principle of unreality.

Metaphysical Commitments

The key metaphysical commitments are about the nature of human beings, the human environment; economic phenomena and markets. The most crucial of course are the metaphysics of human beings and, their environment. The conceptual analysis of homo economicus implies that the homo economicus is an individuated, self-loving, hedonistic (prefers pleasure to pain and an optimizer) being who has free will and perfect knowledge that he or she employs to achieve the hedonistic goals (maximum pleasure, maximum profit; maximum rent and maximum levels of exploitation as the case may be). From a metaphysical standpoint, homo economicus obviously fails the existence question: *does the homo economicus exist*? Real humans have a diversity of motives and intentions; act irrationally, are inefficient, select adversely and sometimes are helped to choose because they are unable to rank alternatives or choose a satisfactory option.[44]

A reflection on metaphysics reveals that in categories of things that exist, humans are categorized as substance[45]; spatiotemporal (entities that occupy certain location in space and have own history) and contingent beings (beings that could fail to exist) that have essential nature. Human beings are obviously spatiotemporal: they exist in time and space both of which are

[44] Even after due research about laptops and about reviews, before buying this laptop I am using to write this inaugural, I have found several defects that convinces me that I did not make the best choice given available alternatives.

[45] Substance exists by itself and independent of all else. For example, in a red ball, the ball is the substance while the red is not (it is an accident).

insignificant relative to their complement sets. It is also true that human beings have essential qualities that make them human: e.g., they are mammals; they are social beings, etc. They also have accidental qualities; physical attributes like skin, eye and hair color, tall, short, greed, passion for something, etc. Greed is not an essential nature of man; it is an accidental quality. It is therefore, a major flaw to mistake an accidental quality for the true nature of man.

It is well documented that John Stuart Mills was opposed to gender inequality or racial explanations of the circumstances of people. He believed that human beings shared the same essential nature and strongly supported the anti-slavery movement in the United Kingdom. It is possible that his preference for a homogenizing concept of human beings was consistent with his views about the essential equality of human beings. The problem however, was that he chose a dismal stereotype of human beings as passionate about wealth accumulation. Subsequent followers, made the transition from passionate about wealth accumulation to rational hedonism (utility maximization and profit maximization) following his example to exclude all motives and intentions other than the motives of wealth accumulation.

More than 2000 years before Mills, Aristotle's stereotypes of humans comprised three categories: "truth seeking", "esteem seeking" and "material seeking". In Aristotle stereotype, the truth seekers were the best while the material seekers the worst types of human beings. Adam Smith's stereotype of humans in his *Theory of Moral Sentiments* also differed from Mills's. Adam Smith's stereotype was that humans had a tendency to empathize:

> How selfish so ever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it. Of this kind is pity or compassion . . . for this sentiment, like all the other original passions of human nature, is by no means confined to the virtuous or the humane, though they perhaps may feel it with most exquisite sensibility, the greatest ruffian, the most hardened

violator of society, is not altogether without it. (Adam Smith, 1759).[46]

The *dismal stereotyping* of human beings in economics and the rationalization of the stereotype may have made economics a self-fulfilling cognitive enterprise. Studies have found that economics students are more selfish than their counterparts in American Universities (Bauman & Rose, 2009); economic graduates are more likely to free ride(Marwell & Ames, 1981); defect in prisoner's dilemma games(Frank, Gilovich, & Regan, 1993) and take bribes (Frank & Schulze, 2000). If economists and their students imbibe what they hold as core, what is the guarantee that their learning and their doing of economics would not be simply a means to satisfy their own rational greed? And if that is the case, how can economics be a discipline that helps individuals, social organizations, governments and multilateral actors make choices that promote the commonwealth of humanity? How can society guarantee that economists and students of economics will acquire values of honesty, consistency, and respect for data and problem solving in their doing and learning economics? I am convinced that a significant number of economics students and most practicing orthodox economists today either do not know; do not care to know or do not share or live by the core values of Adam Smith, John Stuart Mills[47] or Williams Stanley Jevons.[48] The studies (Marwell & Ames, 1981; Gilovich, & Regan, 1993; Frank & Schulze, 2000 and Bauman & Rose, 2009) indicate that economics has significant *indoctrination effects* on graduates of economics at least in the United States.

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[46]Smith suggested that God and not man cares for the universal happiness of all rational and sensible beings and that man has been limited to caring for his own happiness and the happiness of his family, his friends and his country. Even this does not justify the dismal stereotype of rational greed.

[47] John Stuart Mills support for the anti-slavery movements and women's right is well documented. His support for the anti-slavery movement incurred the wrath of Thomas Carlyle who in his bigotry attacked Mills and economics for daring to question the idea that all humans have the same essential nature.

[48] Mark Blaug's account said of Jevons; "His letter to his family in those early years already reveal a keen interest in social questions and a profound sense of mission in his life". Also, that in the *State in Relation to Labour* he roundly condemned the maxim of *laissez faire*.

The point therefore, is that the dismal stereotype of human beings makes economics dismal and ensures that economics promotes the interests of the strategically advantaged greedy individuals and organizations; it has the potential to corrupt the values of economists. We have seen evidence of that in the rise of "Oligoths" in Russia; and in Nigeria, the effects on public policies and the consequences. Prior to President Putin's assumption of office in Russia, greed had decimated a once powerful nation to a point where nuclear scientists had to accept security guard duties to feed their families. In one sad situation in Russia, a man killed another who stole from his potato farm. As if that was not bad enough, the killer's neighbours justified the act: he was protecting his family from starvation!

It is true as Robbins (1935) held that *time is short* and *nature niggardly*. However, human beings are part of an organic system and their interaction with their environment is not solely to source for resources to satisfy their greed. Aristotle and the Scholastics held that resources are not meant to satisfy human greed but human needs. Satisfying needs will (1) minimize inequities; reduce considerably the intensity of scarcity and (2) enhance sustainability. A needs-resources relation will make the world less unequal because the needs-resources tension is significantly lower than the wants-resources tension. There is therefore, a greater likelihood of much less competitive struggle by humans for resources. And because competitive struggle cause conflict along social tension points, a needs-resources relational world is more likely to generate considerably less frequent and less intense conflict. Also, human beings are more likely to have more time for more spiritually uplifting activities hence, less demand to fill the emptiness that a life of rational greed creates in humans. The need to manage human proclivities by letting them tyrannize over their bank accounts will be considerably limited and help to mitigate the great danger of the fact that the *tyrannies of greed are cancerous and fatal*. In contrast, the idolization of rational greed has widened inequities, tightened intensity of scarcity and has greatly depleted natural resources, the ozone layer and endangered many that have become unfortunate victims of the fury of nature.

Institutional thought has enlightened us about how humans in their interaction with each other and with their environment build

institutions that embed incentives. The institutions that strategically advantaged rationally greedy persons and organizations build serve their interests. This was visible in the institutions colonial authorities built in Africa, Latin America, Middle East and Asia. It is also visible in the global financial and trading architecture that the US led its allies to build after the Second World War and it is visible in the Western banking practices that encourage dictators to keep wealth stolen from their nations in Western banks and to appropriate the funds when dictators die[49]. Clearly, rational greed is devoid of wisdom and morality and disables nations of the world from working together to build global organizations and institutions on global ethical standards in the mould of Adam Smith's *Theory of Moral Sentiments.*

I have already argued that the *nature* of markets in orthodox theory is unreal. Real or concrete markets and real economic actors are imperfect. Also, markets are dynamic processes. Hence, the idea of market equilibrium as a norm is a fallacy.[50] I know that the Neo-Keynesians have sought to integrate market imperfections, price and wage rigidities in their analysis yet; they remain under the cognitive control of orthodoxy. The Austrians have recognized that equilibrium is a misnomer because markets are discovery and creative processes. Still, they too have found it difficult to mount a successful challenge to free economic thought from its cognitive bondage.

Two basic principles in Robbins conceptualization will survive and be foundational parts of any new economics. These are the *principle of trade-off* and the *principle of opportunity costs.* The principle of trade-off applies to both needs-resource and wants-resource concepts of scarcity. In both cases, the use of resources for one end means it is not available for another. The principle of opportunity costs implies that there is a next best alternative that we are foregoing in any application of resources. Hence, the true cost of the choice, is what we cannot have. Though economics limits the applications of the principles to material choices in consumer and

[49] Key examples are Nigeria's Sani Abacha and Zaire's Mobutu Sese Seko.

[50] To confirm that markets are dynamic processes, one just needs to go online and follow trade in financial instruments in the course of a day. Alternatively, one could plot macroeconomic data on product, labour and housing markets. In both cases, one will observe movements and different degrees of volatility.

producer theories, the principles also apply to non-material choices. They apply for instance, to purpose of economics and to its commitments (epistemological, metaphysical and ethical). A commitment to serve the interests of greedy rationalists implies that economics is trading-off the interests of the human commonwealth for social cohesion. For economics cannot serve greedy rationalists and serve the society at the same time. In its revealed choice, economics is also forgoing the empowerment of human beings to make morally sound and wise choices. Therefore, the true cost of the chosen purpose of economics is the foregone capacity of humans to make morally sound and wise choices and the consequences of such failures. Similar analysis could be made for the commitments (epistemological, metaphysical and ethical).

Ethical Commitments: Values

There are at least two levels of flaws. The first flaw is of course, that vices (self-love, materialism, hedonism, vanity, etc) are the foundation of orthodox economics.[51] Apart from making economics dismal, the vices lead to *spiritual deficits*. The spiritual deficits manifests for instance, in the perceptions of property and its use. The view that property should be privately owned is axiomatic in orthodox economics. The ancient debates between Plato and Aristole and the views of the Scholastic indicate that the orthodox view is unique and consistent with the orthodox stereotypes of humans as self-loving hedonists.

In the ancient debate, Plato and Aristotle held opposing views. Plato favoured *communal ownership* because in his ideal political system led by Philosopher Kings, ownership of private property will distract them. On the other hand, Aristotle favoured *private ownership* because he believed humans can more efficiently manage what they own. In addition, private ownership enables human beings to engage in philanthropy. Nevertheless, Aristotle advocated restrictions on the accumulation of private property and

[51] Some economists have sought to model altruism to generate altruistic preferences and equilibrium (see for example, Frank, 2003). The problem however, is that it is ad hoc and does not sit well with the structure of orthodox economics. Because vices are foundational, changing them will produce a new house.

decried intrinsic motives that predispose some humans to seek wealth and esteem instead of truth. The Scholastics such as St Thomas Aquinas justified private ownership along Aristotelian lines but added a *spiritual dimension*: private property is held in trust for God and holders must be willing to use property in godly ways including sharing with those who do not have. The uniqueness of the orthodox view is that while it agrees with Aristotle and the Scholastics that private ownership of property is the norm, it does not accept Aristotle's *ethical restrictions* on accumulation or the Scholastic *spiritual restrictions* on the use of private property.

The orthodox view or the conventional wisdom about private property raises prudential questions for humanity. What is wise, about a convention that promotes the worse possible human stereotypes and separates itself from sound morality and wisdom?"A conventional wisdom that separates itself from sound morals and wisdom is more appropriately, "conventional foolishness". For in the words of King Solomon, "Wisdom is in every thought of intelligent people; fools know nothing about wisdom" (Proverb 14:33) and "It is better -much better to have wisdom and knowledge than gold and silver" (Proverb 16:16).

The second flaw is the inherent *ethical bias*. John Stuart Mills, William Stanley Jevons and Hausman in their consensus on a separate realm for economics shut-out wisdom and moral questions from economics. Yet, the literature on ethics makes it clear that every choice raises three questions about efficiency, morality and wisdom: Is the choice of X efficient? Is the choice of X prudent? Is the choice of X right? While a morally sound choice is not unwise, an efficient choice may be foolish and unwise. For instance, technology may enhance the efficiency in the drilling of oil and gas resources; yet efficient depletion of the resources and of the ozone layer that follows make the efficient depletion foolish and immoral because it imperils the sustainability of humanity. Similarly, when global central banks engage in printing of money to promote the competitiveness of their economies, a fallacy of composition situation arises that makes their actions unwise. Their actions may also lead to asset price bubbles that will in the future undermine economic growth, employment and wellbeing when the bubble bursts. The printing of money to get out of recession may also be immoral because the printing of money by central banks reduces the

value of money and amounts to regressive tax. In the case of the US which has the global currency (US$), printing of money and using it to buy financial assets is immoral because its policies adversely affect many nations and many people. It is also unwise because it may trigger currency wars and asset price bubbles that endanger its medium term prospects. Clearly, solving the national and global (economic, social and political) crisis requires wise and morally sound choices and actions.

At the 2012 World Economic Forum's Global Agenda Conference in Dubai, two themes were recurrent: *co-operation* and *coordination*. There was general agreement on the thesis: *co-operations and coordination are necessary to solve the grand problems of the world* (low growth, record unemployment, inequalities, poverty and environmental problems).[52] However, as Professor Garba pointed out in her presentations during and after the meeting (1) where will the people with tendencies to cooperate and accept to be coordinated for the good of the commonwealth come from: universities, government or the private sector? (2) are our universities training people to compete to achieve private goals or to cooperate and to submit to coordination towards the achievement of the common good?

Exemplars

The exemplars for economics in terms of epistemological and metaphysical commitments are natural science, particularly physics. Both Mills and Robbins were inspired by physics: movement of planets (Mills) and mechanics (Robbins). The problem, as noted by those who preferred biology as an exemplar is that physical objects are nothing like human beings. Economics would therefore need better exemplars than physics and mathematics which have considerably influenced the construction of the modern version of orthodox theory.

[52] Game Theory has shown that competitive outcomes may generate Nash Equilibriums that have lower values of the game than cooperative solutions. In other words, cooperation generates better outcomes than competition. This is easily shown in the case of the Prisoner's Dilemma where because of a lack of trust and selfishness, the criminals end up with lengthier sentences.

Structure

The implications of the flaws in purpose and in commitment (epistemological, metaphysical and ethical) on validity of orthodox economics are easy to see from Figure 2. With such flaws in the foundation (value system and world view), conceptual system and theorizing system; the hierarchy of theories stands on fallen legs. More importantly, they stand on moral and spiritual deficits that corrupt orthodox economics and render it *unable to help humanity to make wise, morally sound and effective choices* at all levels of social formation or to enthrone justice and fairness in the economic system.

The moral and spiritual deficits are noticed in the spread and deepening of rational greed in strategically advantaged economic agents and, the exploitation of advantages for hedonistic ends regardless of human and social costs. The moral and spiritual deficits have also influenced the transformation of the modern business to a profit making machine which treats workers and managers as replaceable parts(Schwab, 2010, P. K. Garba, 2012) and in the process destroying the sense of community that makes businesses serve the good of the commonwealth. Increasingly, material progress that rational greed produces comes at great costs to humanity and to its environment. Economics will better serve humanity without moral and spiritual deficits as its foundation. And without its moral and spiritual defects, a new economics will emerge.

Essentials of a New Foundation

The essentials of a new foundation are: a new purpose; new epistemological commitments; new metaphysical commitments; new ethical commitments and a new structure. The specifics of the new purpose, epistemological commitments; metaphysical commitments; ethical commitments and structure should emerge through purposeful discussions among economists and between economists and non-economists; for economics is too important to be left to economics alone. What I offer here, are my preliminary views.

Purpose

The basic question is; what *should* be the purpose of economics? The question is not a positive question and therefore cannot have a positive answer. Because purpose is a *value-laden* concept; it may not be easily settled by appeal to facts. Often in class I ask, both undergraduate and post graduate students why they are learning economics? The answers are usually diverse: I want to acquire knowledge; I want to serve my community; I want to improve my chances in the job market; and so on. Of course, there are also those who study economics as acts of fate. Whatever, may be the entry point to economics, the purpose of economics must be clear and virtuous. Economists should avoid the dishonesty about being pure spectators that are interested purely in seeing, thinking and understanding economic phenomena through "objective" and factual analysis of social relations. The truth is that Adam Smith, Mills, Jevons; Keynes; Friedman; Stiglitz, Eskor Toyo, Aboyade, Kayode, Onimode, Oyejide, Olofin, Kwanashie, Attah, Ojowu, P. K. Garba and indeed, most if not all, economists were key participants in social phenomena. Their interests were not limited to seeing, thinking and understanding economic phenomena, they were deeply involved in social actions and changes they believe in. To all of them, *economics was a means not an end*. Therefore, *it is the end of economics that defines its purpose*.

I therefore suggest a clear purpose for economics, to empower human beings (in households, businesses, social organizations, governments, bilateral and multilateral organizations) to make *morally sound* and *wise decisions* on all matters and relations that involves the use of resources at all times.

Morally unsound and unwise decisions are plagues on the use of resources and on the social, economic and political relationships that humans have developed to support their use of resources. The Great Depression, the episodes of financial and economic crisis after the end of the Gold Standard: the external debt crisis of the 1980s; the currency crisis and Japanese property bubble of the 1990s; the dotcom bubble of 2000; the sub-prime mortgage generated crisis of 2007-08 and the current crisis in the Euro zone are too costly in terms of human lives; misery; social and political instability.

Indeed, if economists are made to pay for the consequences of their work, there is a great likelihood that few can still be eligible or, be willing to practice orthodox economics today. I have argued before, that economists should be held accountable for the advice they give and which diligent implementation leads to major social costs. I am convinced for instance that were that to be the case, many who arrogantly impose corrupt and external interest serving policies in the developing world in the 1980s would have ceased to practice economics. The main point is, economists cannot analyze human behaviour in terms of constraints yet practice economics without constraints. This unconstrained practice of economics partly explains why theories that fail empirically thrive in the abstract and continue to influence the real economics even at great and rising human costs.

I believe medicine offers economics some exemplars in this case. Practitioners prior to practice swear to the Hippocratic Oath:

> to be *loyal* to the Profession of Medicine; to be *just* and *generous* to its members; to lead lives and practice medicine in *uprightness* and *honour*; to practice only for the *good* of the sick to the utmost of power; to hold self far aloof from *wrong*, from *corruption*, from the *tempting* of others to *vice*; to exercise your art *solely for the cure of* your patients, to give no drug, perform no operation, for a *criminal purpose*; to treat patients with inviolable *confidentiality* (summarized from Microsoft ® Encarta ® 2009)[53]

The purpose of the oath is to upgrade the ethical standards of medicine to the highest human standards to protect the patients and to compel practitioners to practice by the standards of medicine. The central principle for economics is the need for clarity about core values of economic practice and institutionalization of accountability.

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[53]"Hippocratic Oath." Microsoft® Encarta® 2009 [DVD]. Redmond, WA: Microsoft Corporation, 2008.
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Epistemological Commitments

Two key changes are required. The first is the shift away from positivism which makes claims about human nature, environment, phenomena and markets irrelevant. This does not mean that economists will no longer apply deduction to axioms/hypothesis. But that axioms/hypothesis must be grounded in stylized facts of observed economic phenomena, not a product of someone's mind and argument about some scientific standard. This would avoid the type of tautologies and the employment of unreal claims that theoreticians now make to arrive at ends predetermined by the unreal assumptions.

The second epistemic issue concerns the inclusion of faith in economic practice. It is not valid to propose that faith does not play an important role in the economic decisions that human beings make. The Scholastic's argument against usury and their ideas about price, property and consumption are anchored in Christian Doctrines. Similarly, the idea of non-interest banking a key principle of Islamic banking is anchored in faith. To exclude faith in understanding behaviour is a fundamental flaw for the simple reason that for most people, *their reasoning and sense perceptions are not independent of faith*. And that is true even for "great economists" and "great philosophers". I have argued earlier that Bertrand Russell's view of theology and its relationship to science and philosophy was influenced by his faith (for a lack of faith is faith). The same could be shown for most active players in a diverse set of cognitive enterprises.

Faith is defined as "a trusting belief in a *transcendent reality*, or else in a *Supreme Divine Being*" Further, that like trust, faith "involves a concept of future events or outcomes, and is used conversely for a *belief* "not resting on logical proof or material evidence." The proof of faith is not the issue: the issue is that faith influences reason, senses and behaviour and that if we want to understand behaviour, we need to understand how faith influences behaviour. An argument I offered at a seminar in 2009 is:

> Models of human nature are foundational to economics.
> Faith is foundational to human nature.
> ---
> Therefore, faith is foundational to economics

This avoids the debates about epistemic validity of faith.[54] Analyzing the possible effects of faith on human behaviour about the use of resources should acknowledge differences in *purpose* and differences in *time horizons* considered in decision making. If a person believes that he exists to fulfill a transcendent purpose, then his behaviour will be influenced by that belief. Property rights, prices (just and unjust), usury (permissible/non permissible); investment options (permissible/non permissible); consumption (permissible/non permissible); institutions; roles of government; individual-state relations; inter-personal relations are subject to influences of faith. These issues may also, be influenced by faith in the afterlife. An atheist that does not believe in an afterlife may have different values from a person that believes in an afterlife that may affect attitude to wealth; and all the elements in the set of issues subject to the influences of faith.

Therefore, *means*, *ends*, the *relationships* between the *values* embedded in the relationships are at the least, possibly influenced by faith. In other words the choice set, preferences and choice are subject to the influences of faith. Even on that score, faith ought to be part of our understanding of human behaviour. For to rule out faith *abinitio*, and focus only on what we *see* and *what is logical* to us is to overstate our sensory and mental abilities and to enthrone ignorance because what we *can* see and what our minds on their own *can* conceive are insignificant relative to what we cannot see or conceive in our minds. We must therefore, give room to intuitions and to revelations at least, as possible influences on human behaviour.

Metaphysical Commitments

Given that the purpose of economics is to empower human beings (in households, businesses, social organizations, governments, bilateral and multilateral organizations) to make *morally sound* and *wise decisions* on all matters and relations that

[54] *Logical positivism* holds that "any belief held by faith is invalid" because it cannot be tested. *Fideism* holds that "belief can only arise from faith - reason and evidence cannot lead to truth" while "*foundationalist*" argue that "beliefs rest ultimately on beliefs accepted by faith" and C. S. Lewis holds that "faith is merely the virtue by which we hold to our reasoned ideas, despite moods to the contrary."

involves the use of resources at all times, then the metaphysical commitments of economics must derive from this purpose. The key consistency issues are three-fold: categories (human beings, environment, economic phenomena and institutions); basic relations and ontological approaches.

First of the categories is human nature. Human beings are not concepts. They are real and their general nature is fairly known. Therefore, we do not need to either assume or assert but to study. Given that human beings have an *essential nature* (attributes that make humans human) and *accidental attributes* (non essential attributes such as skin color, gender, class, or nationality); what is needed is to understand how attributes relate dynamically and how together they influence human behaviour. Second, the environment also is real. It is known that the physical environment is an organic system with humans as a part of it. Also, that the physical environment facilitates the material process of production, consumption, exchange, distribution and waste disposal. Knowing how environmental balance is influenced by economic phenomena is important and should be integral to economics rather than an interpolation. Three, the Robbins view about economic phenomena is right in part. It should be modified (1) to integrate environmental sustainability in economic analysis; (2) to recognize the two notions of scarcity: that is, scarcity as a ***needs-resource gap*** and scarcity as a *wants-resource gap* and (3) to include economic activities that are not traded. Integrating environmental sustainability ensures that economic behaviour is compatible with environmental sustainability. As a result, orthodox assumptions such as free disposal will not be part of economic analysis. Also, the demands for environmental sustainability will factor into production and consumption decisions as binding constraints. The two scarcity concepts have different implications for economic analysis.

A needs-resource gap is smaller than a wants-resource gap. Therefore, the former is likely to generate less uncertainty, anxieties and less competition. On the other hand, a *wants-resource gap* concept of scarcity is likely to generate greater uncertainty, anxiety, competition, less peace and orderliness in the social system. Professor Kassey Garba (Garba, 2013) shared a story that is illustrative. As part of a group that used a Catholic facility for a programme, she requested the cooks in the canteen to serve her group so that the food would go round. The cooks were surprised, for they said the food was more than enough to go round. The cooks further explained that when the Catholic nuns take their food under similar arrangements, what each person serves on her plate was not influenced by their wants, but by the need for the food to go round."

Prof Femi Odekunle used an anecdote to make similar points: Suppose there are two societies A and B each with 10 people and an endowment of N10. In society A, two persons appropriate ₦6, three persons appropriate ₦3 leaving five persons to struggle for ₦1. In society B, the rule is that no one receives more than ₦2 and no one receives less than ₦0.5. In society B, there is greater commitment to order, progress and peace because they all have a stake in the community. In society A, there is less commitment to order, progress and peace and a greater chance of insecurity and conflict.

A more general concept of economic phenomena will remove the false divide between reproduction and production. It is a false divide because resources are used to create values in both reproduction and production. It is the insistence economics to restrict the domain to traded activities that excludes reproduction. In reality, the two spheres are inter-dependent: the more time a woman uses in reproductive activities (cooking, sweating, spending time with children, etc), the less time she has for production and vice versa. The new foundation therefore, will unify analysis of production with that of reproduction. Unifying production and reproduction analysis will require a reexamination of value theory to make it compatible with reproduction also, with the purpose of economics as an enterprise for empowering economic agents to make morally sound and wise decisions and to take morally sound and wise actions.

The basic relations of interests will include *essential nature, accidental attributes and behaviour*; *needs-resources*; *wants-resources*; relations between economic actors in households; in the formal economy; in the informal economy; relations between formal and informal activities; relations between real and financial economies; individual-society relations; individual-government relations; and all sets of principal-agents relations; relations between nations; and so on.

Besides positivism, all other ontological approaches, particularly empiricism and realism, will be useful. Making the purpose of economics clear will turn focus of economics to intrinsic and extrinsic motives, expectations, risks and uncertainties. Economists should also include in their analysis of choice, changes in the accidental attributes of human beings as well as changes in the environment, in economic phenomena, in institutions and in relations. The desire for parsimony and simplicity must be weighed against (1) the heterogeneity of human beings, environment, economic phenomena, institutions and relations and (2) change. This is why it is necessary that economists engage in continuous monitoring of changes in human accidental attributes including motives, expectations and psychological uncertainties as well as in

the environment (physical and social), economic phenomena, institutions and relations locally, nationally and globally.

Ethical Commitments: Values

The fundamental ethical commitment is a commitment to empowering human beings everywhere to make morally sound and wise decisions and to take morally sound and wise actions. This ethical commitment corrects key deficits (moral and spiritual) in orthodox economics. It would also help to correct a third important deficit that is, the institutional deficit.

The ethical commitment also has implications for economic training and economic practice. Learning economics will be more than a cognitive exercise but, principally about acquiring wisdom and understanding. I believe that John Bascom (1877) expresses the point clearly in his definition of wisdom:

> We mean by wisdom the knowledge which gives a *mastery over physical forces*, the *insight which discloses the constructive laws of mind and society*, and that *living obedience* which puts itself in perfect harmony with this innermost truth of things. This wisdom is for men and for States the principal thing. Accepting the proposition, Wisdom is the principal thing, we accept the corollary, and would obey the injunction: Get wisdom; and with all thy getting, get understanding. The applicability of this precept to us in our collective capacity, the State, suggests our theme (Bascom, 1877).

The implication is that learning involves acquiring *knowledge*, *insight* and *character*. In other words, the student of economics must be the antithesis of the *homo economicus* in values. When students acquire knowledge, insight and character, they would be more likely to deploy knowledge wisely in defense of the commonwealth than in the selfish acquisition of things. They will then be more disposed to cooperating to solve concrete economic problems. They would also, be able to help restore the social order that greed is systematically destroying globally and to steer the world away from crisis created by an endless cycle of ethical decay and "broken values".

Structure

What structure of economics is suggested? At this point, only a simple structure is presented. The structure is shown in

Figure 6. It has three hierarchies: *foundation*, which consists of the purpose and the *commitments* (epistemology, metaphysics and ethical); the *dynamic economic space* (environment and economic phenomena) and *purpose driven output* (economic theories and economic advice). This structure requires economists to construct purpose driven theories: theories that generate morally sound and wise economic advice. Constructing purpose driven theories demands continuous interactions between *purpose-driven* economists with the dynamic economic space. At the core of the analysis are the two Robbins' principles: *trade-off* and *opportunity costs*. The third core principle will be the *incentive principle*. However, unlike in orthodoxy, which limits incentive to prices and motivation to greed, the understanding of incentive will be deeper, broader and observed not asserted. Similarly, the motivation will be established not asserted.

The next phase of my research will focus on building such purpose driven economic theories that could inform morally sound and wise choices.

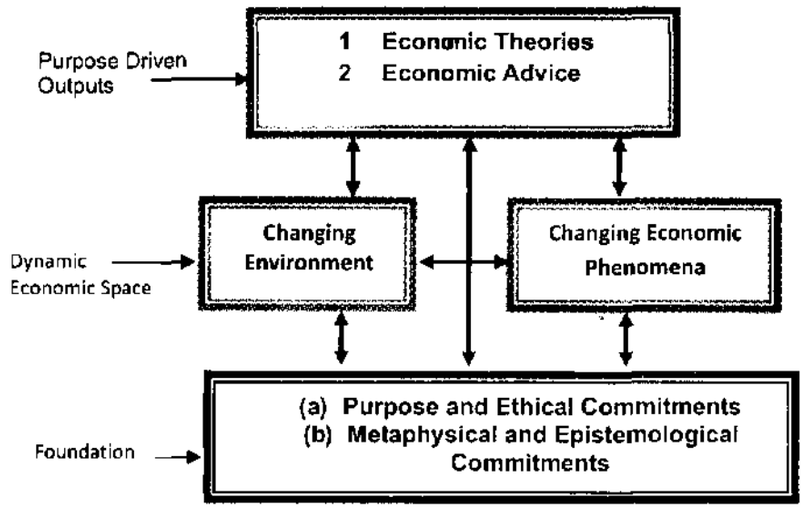


Figure 6: *New Economics and its Foundations*

Conclusion

Arguments for changing the foundation of economics have been made at several points in the history of the discipline particularly, from the 19th Century. Yet, no argument has fatally wounded orthodox economics. The most successful attempt so far

was Keynes's *General Theory*. Before Keynes, Marx (1994), the Historical School, the Institutional School, the Empiricist and Austrian Schools have challenged orthodox economics on many grounds: failure to view consumption, production, distribution and exchange as organic (Marx); ahistorical (historical school); teleological (Veblen, 1994) and lacking in empirical content (Hutchison, 1994). It has also been argued that markets are often in disequilibrium (Austrian School) leading the Austrian School to propose process views of markets: the market as a discovery process and the market as a creative process. After every attack, the orthodox economists re-invent their theory and grow in power and influence. Key examples are the "axiomatization of theory" (after the Hutchison and Lester challenge) and counter-revolution (in the 1970s) to diminish the influence of Keynesian economics in theory, learning and practice (policy making).

It is unlikely that the orthodox will stop being part of economics any time soon. However, the continued survival of orthodox economics despite its foundational deficits questions the willingness of economists to overcome the cognitive control of orthodoxy. Yet, the issue is not whether economists want a change but how long the world will put up with the failure of economics to provide sound directions for governments and people of the world on a sustainable basis.

Mr. Vice Chancellor Sir, the greatest weakness of orthodox economics is that it has no faith in the goodness of human beings. Lacking in faith, it created man in the image of its stereotype and attributes to its created man (economic man) godly powers (perfect knowledge). It then built on it, a hierarchy of theories that are then used to guide the choices and actions of individuals, businesses and governments. Driven by such choices and actions, national and global economies tend to go through cycles of booms and burst that deepen and widen inequalities and disconnections between the financial and the real sectors of the economies.[55]

[55] During the Great Depression, unemployment was about 25% in the United States and higher in many countries and the suicide rates were also higher. In the second Great Depression, similar rates are observed in Spain, Greece, Nigeria and many developing countries. In both cases, the effectiveness of policy was weak. In the more latest case, both fiscal and monetary policy widen income inequalities as

My faith teaches me that a bad tree cannot bring forth good fruits and that a bad tree is known by its fruits.[56] History of economic thought, economic history, the ongoing global economic and financial crisis and my experience in policy making convinces me that without a virtuous foundation, economics will not produce "good fruits" for humanity.[57] Also, that to stand a chance of producing good fruits for humanity, a virtuous way of learning and doing economics is necessary.

This inaugural lecture speaks to economists to convince them to rethink the discipline in terms of what we believe we know; what we teach and how we influence individuals, businesses, social organizations and governments to think about economic phenomena and their options and to make decisions which affect them and many others. That we (economists) are not held accountable for the failure of economics as doctors are when they mismanage their patients in some societies is cold comfort. We may pretend as much as we want but the truth is, expired but resilient economic ideas have done great damage to far too many lives for far too long. The question is *how much longer are we willing to teach unreality and untruths as economic theory and what costs are we willing to make humanity pay*? Every economist has a moral burden and must make a choice: not a choice informed by rational greed but one informed by the moral burden of the great potential of our discipline for good, and great potential for bad, which Keynes and many economists before and after him have pointed out. This is the crux of this lecture.

Mr. Vice Chancellor Sir, the lecture also speaks specifically to Nigerian economists (academic and non-academic), students of economics and departments of economics. The way we learn, teach, research and apply economics is limited by cognitive bondage to orthodoxy. Because of cognitive bondage we limit the boundaries

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the rich benefit more from quantitative easing regime and from fiscal stimulus. The global misery level is obviously rising.

[56] Mathew 12:33 "To have good fruit you must have a healthy tree; if you have a poor tree, you will have bad fruit. A tree is known by the kind of fruit it bears."

[57] I am not denying the material advances of the 20th and 21st century. My point is three-fold. The human costs of the material advances in terms of inequity, poverty and avoidable wars are much too high for the material progress. Two, the material progress has come at great spiritual costs. Three material progress is not sustainable.

and content of economics. Also, we learn, teach, research and practice economics with considerable lag. Our surrender or submission to orthodox boundaries and the lag-effects sap creativity and innovativeness from our learning, teaching and research experiences; and from public policy and policy implementation. Students fulfill requirements for the award of certificates without acquiring the knowledge, insight and character required to solve concrete problems. This is dangerous for students, for the nation and for humanity. It is important therefore, that we rethink what and how we teach and learn economics as preconditions for purpose driven practice.

The global financial crisis has shown clearly, that the premise that some people have all the solutions to global economic problems is false. Therefore, the premise that we have nothing more to contribute is false. It is important that Nigerian economists stop feeding fat on "fast food" (of mainstream and heterodox economics). As teachers, we must encourage our students to be creative and innovative. The practice of limiting the boundaries of economics is a fatal mistake. Economics has much to learn from allied disciplines (marketing, business administration and accounting), from philosophy, cognitive psychology, sociology, political science, law, history, human and physical sciences and faith based disciplines.[58]

In rethinking what and how we teach economics in Nigeria, five issues are critical. First, we need to relax the orthodox boundaries imposed on economics. Economics does not need to assert its separateness from allied disciplines (marketing, finance and accounting); philosophy, cognitive psychology, sociology, biology and history. There is much about purpose, human nature and about the dynamic economic space that economics can learn from these disciplines. Second, we should comprehensively redesign the economics curriculum. We have offered in Garba, Aregbeyen, & Usman (2004) guidance for structuring theory courses to ensure that students have clarity about what is added at each level (100, 200, 300 and 400) how the tools should be synchronized with the theory

[58] The Journal of Economic Literatures' (JEL) classification shows how broad the practice of economics has become. Yet, many departments of economics in Nigerian still operate under the very narrow view of economics.

courses. The comprehensive redesign requires redesign from its foundation and, ensuring that students have sound understanding of concepts, logic, relevant philosophy; methodology of economics and economic history.

Third, we must take a clear decision on the moral burden our discipline places on us. Without it, we may not see the need for fundamental changes to the what, and how of our teaching and learning of economics. Fourth, we should give greater weight to problem solving and inter-disciplinary collaborative work. This will require designing incentive systems to encourage such collaborative works.[59] Fifth, we must inspire our students to contribute to conceptual and theoretical work as well as evaluation of contributions of Nigerian and African economists. I expect to read PhD thesis on the works of Professors Ojetunji Aboyade, Eskor Toyo, Sam Aluko, Adebayo Adedeji, Bade Onimode, Ademola Oyejide, O. Teriba, Ojo, M. O. Kayode, Ibi Ajayi, Siyanbola Tomori, J. S. Odama, Sam Olofin, Akin Iwayemi, Uka Ezenwe, Joe Umoh, Mike Kwanashie, Mike Obadan, Ode Ojowu, Christian Okojie, Akpan H. Ekpo, Ben Aigbokhan, Kassey Garba, Melvin, Ayogu, Charles Soludo and so on.

The lecture also speaks to non-economists. Economic ideas have powerful influence on all aspects of human life. There is no discipline or aspect of human life that is untouched by economics. Therefore, non-economists cannot afford to leave the formation of economic ideas to economists. For if economists "preach" rational greed, how, can you trust them to give morally sound and wise advice that human beings need to live morally sound, wise and decent lives? Non-economists therefore, have to be part of the discussion about the future of economics because the future of economics will influence the future of humanity.

This lecture is for me the ending of a phase. God willing is also, the beginning of a more fruitful one. By His Grace willing, I have resolved to use the gifts God has generously blessed me with for the development of a *purpose driven economics* and to follow His leading. May God help us to add to knowledge; wisdom, understanding and above all, godliness. Amen.

[59] The current promotion guideline will need to be modified to encourage this type of work.

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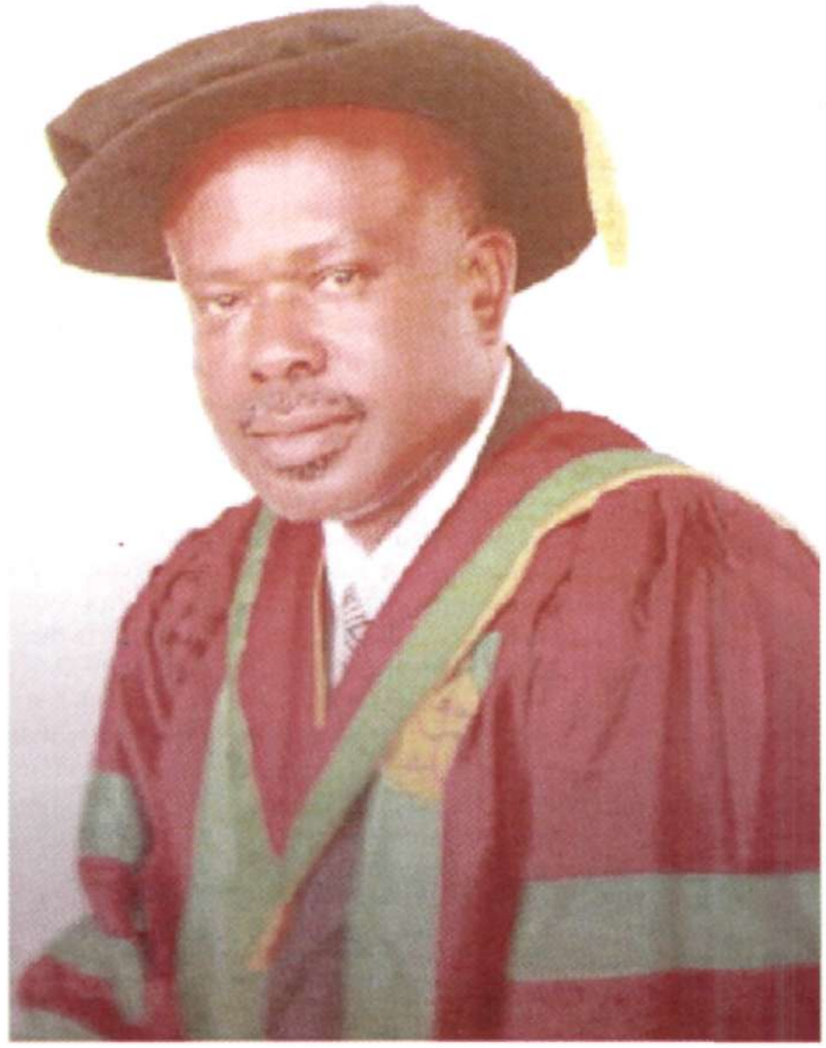
Chapter Three

The Search for Dairy Goat in Nigeria: The Northern Guinea Savannah Experience

The Search for Dairy Goat in Nigeria: The Northern Guinea Savannah Experience

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My profound gratitude goes to God Almighty my creator and my strong hold, His only begotten son Jesus Christ my redeemer and the Holy Spirit my comforter and sanctifier-to the three persons in one God be all the Honor, Adoration and praise forever and ever, Amen. All that I am, have and will become come from Him and for Him; to Him be the glory!

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Thank you for coming and for listening good.

Preamble

I am greatly honored by this opportunity to deliver this Inaugural Lecture. Today's lecture is the fourth from the Faculty of Agriculture and the first from the Department of Animal Science.

I am indeed grateful to the University for inviting me to give account of my academic stewardship after seven years of attaining my professorial chair in the Department of Animal Science, Ahmadu Bello University Zaria. The THRUST of my Animal Breeding and Genetics research efforts in the Department of Animal Science of this great University centered around the provision of quantity and quality milk, meat and egg to overcome hunger and ensure food security in Nigeria. This THRUST I am executing through studies in goat, cattle, sheep, rabbit, poultry and others. To date, I have a total of 203 reported studies to the Scientific community of the world, distributed as follows: Goat 56, Cattle 46, Sheep 33, Rabbit 21, Poultry 38 and Others 9. Today we are going to look at my contributions in this direction in the goat species. My lecture is therefore titled "The Search for Dairy Goat in Nigeria: The Northern Guinea Savanna Experience"

Nothing gives me greater pleasure than to speak about dairy goat in Nigeria, my life passion and dream. In my 26 years of surgeon in Ahmadu Bello University, I have been searching and looking for answers to the problem of food insecurity, hunger and malnutrition through the provision of quality and quantity animal protein. My approach to this, had been in the continuous attempts to develop and empower the small holder livestock farmers by improving their stock performance and production practices, particularly for small ruminants (sheep and goats). My focus on goats," the poor man's cow" in achieving this mission, no wonder has often nick named me the "Dairy Goat Man" among my peers in the Animal Science world. This lecture therefore will present all my research effort in the Nigerian indigenous goats with the main target at developing the truly Nigerian Dairy Goat.

The Search for Dairy Goat in Nigeria: The Northern Guinea Savanna Experience

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Introduction

In Sub-Saharan Africa, probably more than in any part of the world, the livestock sector is integral to the livelihood of the populations. It contributes significantly not only to food security and nutritional quality of the diet but also to national economies. In addition, the demand for livestock product is increasing very rapidly in this region owing to a combination of population growth, rising incomes and urbanization (Hoste, 1999). Therefore, the formulation and implementation of research and improvement strategies designed to meet these challenges is essential.

The World Health Organization (WHO) recommended protein requirement of an adult is 0.5-1.0g/kg/body weight/day (65g/day) and approximately 20g of this should come from animal protein source (Flchowsky, 1999). On the average, about 25g of animal protein is available per person per day and these ranges between 9g in Africa and 65g in north America (Flchowsky, 1999).Thus indicating that protein of animal origin for Africa is far below the recommended 20g per capita per day.

Animal milk is one good source that can be used to bridge this gap. Out of 537403x103 metric ton of total milk production from popular dairy animals (cow, buffalo, sheep and goats), goats contribute 10144 x 103 metric tons which is about 5% (FAO, 1997). In Africa, goats contribute 2078x103 metric ton which is about 9.2% of total milk production (22501x103 tone) from dairy animals in Africa (FAO, 1997).

The properties of a goat are not only determined by its genetic potential but also by the possibilities to manifest this potential. The extent to which it is possible to do so is determined mostly by the environmental factors (climate, feed, housing, health and general care) and animal factors (age , sex, and production capacity). A good dairy goat gives about3.4 liters of milk daily which is 900-1800kg milk in a 305 day lactation period (Haenlein,

1992). Compared to cows, goats will be nutritionally more economical because of their smaller size; requires less food and of a type much cheaper than a cow. This implies that the potential production of milk from goats could be further stimulated to increase the overall milk supply from dairy animals. Above all, goat milk fat and protein are readily digested; and the constituent amino acids (Jandal, 1996) absorbed more efficiently than those of cows.

There is dearth of information on dairy potentials of Nigeria goats. However, reviews of the performance of these goats show favorable reproductive characteristics (Akpa, 1999a; Iyiola-Tunji et al., 2008b) such as high fecundity and short generation interval. The red Sokoto goats are the most numerous (17.3 million) and widely distributed goat breed in Nigeria (Pagot, 1992). They are very prolific; twin births are common and three or four kid births are not unusual (Adu et al., 1979; Abubakar et al., 2013).

The Red Sokoto goat is the predominant breed of goats in Nigeria. It is commonly found among the agro-pastoralist mainly within the northern sub-humid and semi-arid zones of the country (Akpa et al., 2001a). Available information on the milking of indigenous African goats indicate that not much is known about their dairy characteristics (Akpa et al., 2001b). From existing records, lactation milk yield ranged between 24.0 and 120.3kg, with peak yield observed in the Red Sokoto goats of Nigeria (Egwu et al., 1995; Ruvuna et al., 1995; Akpa,1999b). Ehoche and Buvanendra (1983) reported that the average Red Sokoto goat produced 545g of milk per day. Also, in monitoring Red Sokoto goats on the field, Akpa and Duru (1999) showed that one day or average of two days record in a week was adequate in estimating total milk yield and therefore, could be used to monitor their yield characteristics.

The milk production of Red Sokoto goats at the agro-pastoral system for 120 days was reported to be 79kg with an average daily yield of 0.664kg (Akpa1999b). They are easily affordable to small scale farmers which make them or their crosses ideal dairy animals for rural farmers. Therefore, the overall objective of this lecture is to highlight my research experiences in goats aimed at promoting effective, efficient and sustainable dairy goat development in Nigeria. The presentation is grouped into goat production and management; goat herd structure and breeding practices; reproductive characteristics; body growth and measurements;

Morphological and their gene, and genotypic frequencies; matrix of genetic distance; blood biochemical polymorphism; adaptive and blood biochemical characteristics; milk yield, composition and estimations; lactation pattern and characteristics; mammary morphology and relationship with milk yield; incidence of supernumerary teats; genetic parameters and relationship estimations; and genomics studies.

Goat Production and Management

Africa has a population of 205 million sheep and 174 million goats, representing approximately 17% and 31% of the world total, respectively. About 75% of African livestock are associated with smallholders and agro-pastoral farming systems. Nigeria has over 38 million goats representing 4% of the world production (FAO, 2006), contributing about 20% of all the meat eaten in Nigeria. The potential of goat production in Nigeria is high as goats are found in all the ecological regions of the country. The high percentage of these animals are raised at small holder farmers level where they are managed extensively under the traditional system of production (Ikwuegbu et al.,1992) which had evolved different strategies and practices to tackle livestock production problems (Akpa, 2001; Akpa et al, 2002b; Akpa and Mohammed, 2004; Iyiola-Tunji et al, 2010). Despite this immense contribution to the world population of small ruminants, the African small ruminants produce only 14% of the worlds' milk and 15% of the worlds' skin (Ademosun, 1994).

Urbanization tends to require more processed foods, high value cereals, livestock products and vegetables. To meet this demand, agricultural production must increase and become more market oriented to supply urban areas. For livestock, this can be improved through better management. Production problems, possible interventions and animal performance need to be identified within the prevailing system. On-farm work can be complemented by on-station test for comparative performance evaluation and technology development. Therefore, for any production improvement to be successful, it must produce results relevant to the production system and increase economic returns to the producer. Studies were conducted on household goat herd size and factors affecting it in Zaria (Akpa et al.,1995b). The results revealed an average herd size of 19.8 goats which was significantly influenced

by source of foundation stock, labour and location. There was strong positive relationship (r = 0.64) between herd size and family size and length in production. Attempts to elucidate the impact of management strategies on reproductive traits of goats at a small holder level (Akpa et al.,1995a) revealed that grazing period, water and feed supply significantly ($P<0.05$) influenced age at 1st conception and maximum litter size obtainable. Goats that were grazed morning- evening and supplemented with feed and regular water supply performed better than others.

The value of fodder for goats has been emphasized and their utilization represents an important strategy in developing countries (Akpa et al., 2000b). The relative low productivity of animals in the semi-arid zone of Nigeria is mainly due to shortage of feeds and fodders, especially during the dry season period of the year (Hamidou et al., 2008). Types of feed and feeding system and their effects on household goats' production in Zaria were investigated (Akpa et al., 1995b). The feed types used by goat producers in various combinations either as conventional rainy or dry season feeds were offals, grasses,(hay or fresh), cotton seed cake (CSC), groundnut cake (GNC), groundnut haulms, beans pods, food scraps, leaves, potatoes, farm residues and silages. Most producers grazed (97.8%) their goats mainly in the morning and evening (46%) and all time (39.1%). When supplementary feeds are provided for goats, most producers (92.4%) do not measure the quantity given; and about 71.1% of the producers offer mineral- vitamin supplements to their goats.

To mitigate shortage of feed for goats in the semi-arid zone of Nigeria during the dry season, feeding combinations of supplement mixtures of maize bran, beans pod, Dichrostachys cinerea browse and gamba grass were assessed using 15 growing goats for 90 days (Akpa et al.,2000b). All the feeding combinations supported positive weight gain in the goats. Feeding of D. cinerea with or without supplement mixtures improved feed intake, weight gain and feed efficiency of goats during the dry season in the semi-arid zone of Nigeria. However, further studies are required to determine the optimum level of D. cenerea inclusion in feeds and possible anti-nutritional factors in it.

Studies conducted on milk production of Red Sokoto goats had variable results (Ehoche and Buvenadran, 1983; Akpa et al.,

2001b; Akpa et al., 2002a; Akpa et al., 2008). Much of these variations could be attributed to the management system under which the studies were conducted. A comparative study of milk production behavior of Red Sokoto goats under agro-pastoral and institutional system in the semi-arid climate of Nigeria (Table 1) revealed that milk production performance was better for agro-pastoral system (23.5- 69.7%) than institutional system, except for lactation peak (8.0%) and persistency (22.0%) (Akpa et al., 2008). The differences in the two systems could be attributed to differences in nutrition and management of the goats. The agro-pastoral system had a better potential in terms of feed and water supply for milk production but lacked the management ability for sustainability.

Table 1: Effect of management system on lactation characteristics of Red Sokoto goats

Characteristics	Institution	Agro-pastoral	Deviation (%)
Number of observations	20	20	20
Initial yield(kg)	0.447 ± 0.052^{b}	0.759 ± 0.066^{a}	-69.69
Average daily yield (kg/d)	0.439 ± 0.027^{b}	0.542 ± 0.036^{a}	-23.47
Total yield (kg)	52.679 ± 3.210^{b}	65.044 ± 4.313^{a}	-23.47
Peak yield (kg)	0.7454 ± 0.046^{b}	0.999 ± 0.105^{a}	-32.50
Peak week	5.250+0.624	4.800±0.531	+8.57
Persistency (%)	104.300 ± 6.587^{a}	80.599 ± 1.485^{b}	+ 22.72

a,b means on the same row with different superscripts differ significantly ($P<0.05$)

Management and improvement of any breed within a given environment will depend on identifying the major environmental constraints to performance and devising means to alleviate or control them, and on evaluating the breed for its adaptability to cope with constraints that cannot be readily controlled. Knowledge of these constraints will be useful in the modification or improvement strategies and / or adjustment of their performance.

Studies were conducted (Akpa et al., 2009; Abubakar et al., 2013) to examine the influence of age and month of mating on litter size (LS), kidding interval (KI), kidding weight (Kwt), mating weight (Mwt), and body size characteristics in 1000 Red Sokoto does of small holder farmers in Kano State. The results showed that the effect of age was significant ($P<0.01$) on all the measured parameters except post kidding weight gain (PKwtG), post kidding rate of gain (PKRG), and post kidding weight change (PKwt?). Litter size (LS), mating weight (Mwt), kidding weight (Kwt), 60 day

post kidding weight (60dPKwt) and the linear measurements (HW, BL, CG) increased with age and parity of the doe. The significant effect of age on the body size characteristics shows that age is a major determinant of growth and physiological development of the animals. It also revealed that the physiological and morphological growth of the animals go concurrently with age. However, the growth rates usually increase at a decreasing rate with advancement in the age of the animal. Akpa et al,(1998a) reported that the live weight of Maradi goats increased from birth to about 25-30 month of age and appeared constant thereafter. Litter size also increased with age indicating that younger and lighter does might produce less litter size than the older does (Alphonsus et al., 2010). The effect of month of kidding was significant (P<0.01- 0.05) on Mwt, Kwt, 60dPKwt, HW, and CG. This observation suggests the importance of designing breeding programme of the doe to coincide with the period of feed availability so as to ensure optimum live weight required for desirable conception rate and birth weight of kids. Mating weight and kidding weight are strongly related (Rafiq,1995) and were observed to increase with age, indicating that older does might give birth to heavier kids than the younger does.

In another study conducted (Akpa et al.,2011a), parity was one of the factors that exerted significant (P<0.05) influence on birth weight of the kids, with the concurrent increase in birth weight with parity up to the 5th parity and declined thereafter. This suggested that beyond the 5th parity the birth weight of the kids might depreciate. Also parity was observed to exert significant influence on the body weight of the kids at 1, 3, 6 and 9 month of age (Alphonsus et al., 2010), with the kids of parity 5 maintaining their superiority in weight, probably due to their initial advantage in higher birth weight.

Goat Herd Structure and Breeding Practices

The knowledge of the smallholder herd structure and the system of management is essential for identifying opportunities to shape the future of small ruminant production in Nigeria. There is, therefore, need to study the herd structure of this smallholder goat Production and quantify the production, reproduction and socio-economic issues that affect goat production. This is expected to influence policy formulation that may lead to economically

sustainable production in smallholder livestock systems. Therefore, a survey was carried out in Kano State to evaluate the smallholder goat herd and breeding structure (Akpa et al., 2010a, Akpa et al., 2010b). The choice of Kano State for the study was based on the fact that in the traditional setting of Kano area which is in northern Nigeria, majority of families own goats. The goat herd distribution showed (Table 2) that the average herd size was 15.5, within the range of 4 to 30 goats. This is lower than the average herd size of 19.8 (Akpa et al., 1995a) and 19.2 in the range of 2 to 70 (FAO, 2009) reported in Zaria. Although the herd size ranged from 4 to 30 with the mean of 15.0 goats, majority of the farmers herd size was between 11 to 20 goats. The herd structure was made of 78 % females and 22 % males with average buck to doe ratio of 1:5.3, this was comparable to the smallholder goats herd structure in Zaria which comprised of 79.3 % females and 20.6 % males with average buck to doe ratio of 1:19.7. The goats showed higher incidence of multiple births (54 %) with twinning rate of 43 %.

Table 2: descriptive statistics of smallholder goat herds in Kano

Characteristics	N	Mean ±(se)	CV%	Min	Max
Herd size	58	15.5±0.38	43	4	30
Young goats	58	3.8±0.55	92.8	0	15
Young males	58	2.1±0.41	120.7	0	10
Young females	58	1.7±0.22	84.1	0	5
Adult goats	58	7.8±0.53	42.8	3	18
Breeding males	58	1.4±0.13	58.7	1	5
Breeding females	58	6.4±0.67	46.1	2	15
Maiden does	58	1.8±0.23	81.6	0	5
Nanny does	58	4.6±0.39	53.4	0	12
Buck to doe ratio	58	5.3±0.40	47.4	2	13
Litter size	58	1.7±0.04	42.9	1	4

N= number of smallholder herd studied

Goat keeping and production are profitable activities and it is known that increasing prolificacy is one of the factors that determine the profitability. The litter size in this study (Akpa et al., 2010b) ranged from 1 to 4 with the mean litter size of 1.7. This is similar to the Litter size range of 1 to 4 with a mean of 1.847 earlier reported by (Amoah et al., 1996) but higher than the maximum litter size of 3 reported by Amoah and Gelaye,(1990). Although litter size ranged from 1 to 4, majority (89%) of the goats had litter size of 1 and 2, with rare cases of quadruplets (0.3%). Litter size in this study

showed a tendency to increase from first parity to fifth parity and a reduction in the sixth parity (Table 3). These observations suggests that the parity level in which does prolific ability reaches its peak is between 4th and 5th parity, thus culling of does from the herd can be done beyond the 5th parity. It may be economically unwise to culled does at the early parities (except for ill-health) when the full genetic potential of their reproductive rate has not yet been fully expressed. This is supported by the earlier reports of many researchers (Das, 1993; Amoah et al., 1996; Akpa et al., 2001a; Sodiq et al., 2003) that the prolificacy of does tended to increase with advanced parity. Multiple births were common in this study; 44% single, 40.5% twins, 14.7% triplets and 0.8% quadruplets (n= 116). This is comparable with what was obtained at Shika, Zaria traditional management system; 32.6 % single, 58.8% twin, 7.2% triplet, 1.8 % quadruplet (n=123) and Niger traditional management system; 56.1% single, 40.9% twin, 2.8% triplet, 0.1% quadruplet (n=1668) reported by FAO (2009). The most frequent litter size was singles (44.0%), followed by twins (40.5%), which together accounting for 84.5% of births. This is comparable to the findings of Amoah et al.(1996) who reported that the most frequent litter size was twins (48.1%), with the next highest frequency being singles (34.6%), together accounting for 82.8% of births. Although incidence of quadruplets was rare (0.8) in this breed it was however observed that it occurred mostly on does of advanced parity. This increase in litter size with advance parity may be associated with the physiological maturity of the doe. It was observed that does giving birth to quadruplets remained in the herd for a long time, suggesting that the smallholder farmers in the study area are conscious of retaining does with high potential for multiple births in order to increase their herd size. Although the farmers started culling the does after the 2nd parity, majority of the does were culled after the 4th parity.

Table 3: The distribution of breeding does according to herd size

Attributes	10 Goats	11-20goats	21-30goats	Overall
Breeding head	48(30)	89(57)	21(13)	158
Breeding males	12(25)	21(24)	2(10)	35(22)
Breeding females	36(75)	68(76)	19(90)	123(78)
Buck to doe ratio	1:3	1:3	1:10	1:5
Litter size (LS)	83(28)	164(54)	54(18)	301
LS1	37(45)	71(43)	29(54)	137(46)
LS2	33(40)	72(44)	24(44)	129(43)
LS3	13(15)	20(12)	1(2)	34(10.7)
LS4	-	1(1)	-	1(0.3)

Figures in parenthesis are percentages

The significant effect of herd size on all the measured attributes in this study (Table 4) underscored the importance of herd size and herd management in the improvement of the herd performance, since performance of the herd is dependent on selecting the right animal for breeding purposes. Therefore, increase in herd size provides large gene pool for high selection intensity which will invariably increase the herd performance. Likewise, increase in herd size may increase the profitability of the farmer. Although buck to doe ratio increased with increase in herd size, it was however observed that the bucks were underutilized particularly in the traditional smallholder management system where bucks are allowed to run with the does indiscriminately. But in a controlled mating system, appropriate mating ratio is used. In this study the buck to doe ratio ranged from 2 to 13. This is far below the buck to doe ratio of 1:30 reported by Das and Sendalo (1990).

Table 4: Effect of herd size on the distribution of goats according to the observed attributes of the herds

Attributes	10 goats (21)	11-20goats (15)	21-30goats (15)	SEM	LOS
Young goats	2.0^{c}	4.4^{b}	10.8^{a}	0.38	**
Young males	1.1^{b}	2.4^{b}	6.8^{a}	0.31	**
Young females	1.0^{b}	2.0^{b}	4.0^{a}	0.17	**
Adult goats	5.7^{c}	9.1^{b}	14.0^{a}	0.33	**
Breeding males	1.2	1.5	1.8	0.13	ns
Breeding females	4.4^{c}	7.6^{b}	12.3^{a}	0.26	**
Maiden does	1.2^{b}	2.3^{a}	2.5^{a}	0.21	**
Nanny does	3.2^{c}	5.3^{b}	10.3^{a}	0.21	**
Buck to doe ratio	4.1^{c}	6.3^{b}	8.5^{a}	0.33	**

^{a,b,c} means within rows with different superscripts differ significantly ($P<0.05$)

In tropical Africa, there was no formal recording scheme on goats. Goats are kept in small numbers which are scattered far and wide in the area. In Nigeria, over 95% of the goats are raised under traditional systems of production. Each animal in a herd is kept for economic and social reasons. Sheep and goat flock structures as reported by Bayer (1989) and Otchere et al (1987) in Nigeria showed that females constituted over 70% of the flocks and a high proportion of males leave the flock before they developed their pair of permanent incisors. To ascertain these reports, a study was conducted (Akpa et al.,2010b) using Fifty-eight (58) randomly selected goat herds in Kano State. The study revealed that the herd structure of smallholder goats in Kano was made of more adult (67%) than young (33%) goats. For the young goats, the males (55%) were more than the females (45%). However, in the adult (breeding) goats, the females (82%) were more than the males (18%). Within the breeding females, the nanny does (72%) were more than the maiden does (28%). This shows that there was a high proliferation of males than females at the younger age which is an indication that the rate of male bearing was higher than the females in these herds. However as the animals grow to maturity the males are probably sold and only few are left for breeding purposes. This suggests that the farmers are conscious of keeping only those animals which are productive for the sake of increasing their herds. Also the decrease in the number of males at maturity could be attributed to differential mortality rate of male and female kids. This is supported by the earlier findings of Chikagwu-Malunga and Banda (2006) that mortality rate of suckling males were higher than the female.

So far, breeding improvements targeted at the smallholder herds have failed to give desired results due to the movement of breeding does in the herds before the projects were concluded (Akpa et al., 2001a). Therefore, any breeding strategy to be employed in order to bring about an improvement in the smallholder herds must understand their breeding structure. Consequently a study to ascertain the herd structure of breeding does of smallholder goat production system (Akpa et al., 2001a) was conducted in Kano using 15goat herds selected at random in 3 villages. A total of 250 breeding does were involved. The results indicate that parity of does in the observed herds ranged from 1 to 10. Twelve percent of the

does within the age range of 5-25 months were yet to kid for the first time. In the herds, does that did not kid at least once, after 25 months of age were culled. However, majority of the does were in their 2nd and 3rd parities and within the age range of 12-25 months. Twinning was common at 1st parity, irrespective of the age of does. Parity and litter size of does were the major determining factors on the observed herd structure for the breeding does. The observed structure indicates that < 12 months does constitute 20% of the herd; 12-25 months 48%, 26-39 months 11.2% and > 40 months 20.8%. Breeding does leave the herds starting from the 25th month of age and at parity 2,4,7 and 10, respectively. A study on breeding practices at the small holder goat herds (Akpa et al., 1998c) revealed that criteria used in meeting the selection of goats were based on health, udder development, bone structure, hair texture and tail structure.

Reproductive Characteristics of Goats

Increased production in goats cannot be possible without considering the reproductive abilities and characteristics of the goats. Also, an understanding of the reproductive characteristics of the goats as affected by various factors whether genetic or environmental is a fundamental component in enhancing their productive potentials (Akpa and Mohammed, 2004; Akpa et al., 2004a). There is dearth of information on the reproductive performance of Nigerian goats. To realize the full potentials of these animals, more work needed to be done in this direction. At the smallholder production system, Akpa et al (1995a) estimated the average age of goats at 1st conception, gestation length, and litter size at 1st kidding and maximum litter size to be 8.4 months, 6.4 months, 1.4 kids and 2.3kids, respectively. In another study, records of 625 kidding and 970 kids of West African dwarf and Red Sokoto goats collected over a four year period (1991-1995) were used to determine the effect of breed, parity, sex and season on gestation length, litter size, litter genotype and sex ratio of these goats (Akpa et al.,2004a). The gestation length, litter size and sex ratio were 147.5 days, 1.8kids and 50.6 %, respectively. Breed and season significantly ($P<0.01$) affected these traits, except sex ratio which was only influenced by season. Parity influenced litter size ($P<0.01$) and sex ratio ($P<0.01$).Litter size (LS), mating weight (Mwt),

kidding weight (Kwt), 60 day post kidding weight (60dPKwt) and the linear body measurements (HW, BL, CG) increased with age of the doe (Akpa et al.,2010a).

In a study conducted using 310 litter size records from 116 Red Sokoto does randomly selected from 22 smallholder goats herds in Kano state (Akpa et al.,2011b), it was found that the mean litter size per doe was 1.7 kids. Further studies on litter size in Red Sokoto goats from pedigree kidding records of 1,798 kids confirmed this finding; that the goats were prolific with an average litter size of 1.7 kids (Iyiola-Tunji et al., 2008b). Equally, sex ratio in these goats showed no deviation from hypothetical sex frequency in farm animals; a condition similar to what was obtained for WAD goats (Adebambo et al., 1994).

Another study conducted (Akpa et al., 2009) using 1000 Red Sokoto does under the small holder production system at Saunawa and Amarzakawa villages in Kano state, Nigeria showed the mean abortion rate(%), litter size(LS), kidding interval (KI), dams' mating weight (Mwt) and kidding weight (Kwt) to be 5.5%, 1.45 kids, 6.90months, 20.4kg and 24.7kg, respectively. The mean kidding interval of 6.9 month obtained by Akpa et al.(2009) was close to the value reported by Awemu, et al (1999) in Red Sokoto goats (215 days) raised under traditional system of management. It is as well very close 240 days reported by Adu et al.(1979) in Red Sokoto goats under intensive system of management. Therefore, it can be deduced from these studies that kidding intervals in Red Sokoto goat is near constant despite the differences in management systems. Usually there is a controlled breeding policy under intensive system of management to achieve the best breeding season, in contrast to the extensive or traditional system of management in which there is no control breeding, animals of all ages and sex are allowed to run together, hence the relative shorter kidding intervals.

Other studies on postpartum interval to conception in Red Sokoto goats (Akpa, 1999a) indicated an interval of 69.8 days. Parity and season significantly ($P<0.05$) influenced it. Does at their 3rd parity had the shortest interval while the longest was for the 1st parity does. Season of kidding was also an important factor that influenced kidding interval of the does. Animals that kidded in the early dry (24days) and early wet (28 days) had shorter intervals compared to late wet (44.5days) and late dry (38.7 days) seasons.

The results of the study suggest twice yearly kidding if does are first bred in the early dry season and rebred again after kidding at the early wet season.

Field assessments can be made of a buck's ability to mate, physical capability to mount, intromission achievement and ejaculation. Assessments can also be made of the quality of semen that the buck produces, which is in turn, related to physical characteristics of its genitalia. Yet whilst it is relatively easy to assess such traits in the field, their values as predictors of buck fertility unfortunately remain the subject of considerate debate. A study (Akpa et al., 2013c) was therefore carried out to determine the influence of age, hair type and body condition score on body and testicular measurements and semen characteristics in Red Sokoto goat. The average value was, body weight 15.02kg; heart girth 59.95cm; stature 54.95cm; chest width 8.37cm; withers height 53.4cm; body depth 32.86cm; body length 57.35cm; rump width 17.03cm; testicular length 12.00cm; testicular . circumference 17.38cm; testicular width 8.69cm; testicular weight 508.7g; semen volume 0.42ml; semen motility 79.52%; semen pH 8.58; sperm concentration 701.13 x 106; and live and dead ratio 0.82 x 106. Age and body condition score significantly ($P< 0.01$) influenced body weight, body conformation and testicular traits, but had a variable influence on semen characteristics. The body weight, body conformation and testicular traits increased with increase in age of the bucks. Hair type had no influence on body weight, body conformation traits and semen characteristics but had influence ($P< 0.01$) on some testicular traits. Bucks with BCS (4) were bigger in size (HG, ST, WH, BL, RW) and weighed more (BW) and had scrotum that are longer (TL), broader (TC), wider (TW), and heavier (TWT); hence produced more semen (SV) than those with BCS(3). The short smooth haired bucks gave better testicular dimensions than the long curly haired bucks. Therefore, the study showed that increase in age and body condition resulted in an increase in body and testicular size while hair type could be used as a predictor of testicular dimensions in Red Sokoto goat.

Another study (Ambali et al., 2013a) was carried out to study the influence of age, hair type and body condition on sperm morphology and cation concentrations in Red Sokoto goat. The observed average value for sperm morphology and semen cation

concentrations (millimol/litre) were detached mid piece 0.52, mid piece droplet 0.61, detached head 0.51, coiled and bent tail 1.01 and acrosome 0.61; Na 94.90, K 67.79, Ca 2.62 and PO4 5.42. Age and hair type significantly (P<0.05-0.01) influenced them. The study therefore revealed that older bucks with short-smooth hairs and higher body condition exhibited less occurrence of sperm abnormalities and appreciable concentration of Na+ than older, long curly haired and lower body conditioned bucks. The result of the study suggested that age 21-24 months, short-smooth hair type and higher body condition is a useful index in selecting bucks for semen quality and optimum performance in Red Sokoto goat.

Maintaining a high fertility by genetically superior bucks producing large numbers of high quality spermatozoa is important for the improvement of overall flock fertility. Any quantifiable physical traits that directly correlate with the fertilization capacity of semen could be potentially used as a measure of semen quality. Sperm production and quality can be affected by both animal size and physiological status. A study was therefore conducted to determine the relationships between body measurements, testicular and seminar characteristics (Akpa et al., 2013d). The result showed positive and significant correlations of body measurements with semen traits and testicular measurements with semen traits; therefore, bucks with larger body size would possess larger testicular size, produce higher semen volume with increased sperm concentration. This can be used to evaluate Red Sokoto goat for breeding soundness and genetic improvement for fertility.

Semen quality characteristics such as motility, sperm number and sperm morphology are of value in identifying breeding males of low fertility in small holder herds. An accurate morphology examination of spermatozoa thus enables the elimination of males with potentially low fertility prior to their use in breeding. The knowledge on correlations of male reproductive traits especially sperm morphological traits with other variables such as semen and testicular traits as well as body conformation traits may have important bearings to indicate the real producing ability of a male for sperm output and quality. A study was therefore conducted (Ambali et al., 2013b) to determine the relationships between sperm morphology, semen characteristics, testicular measurements and body conformation using 31 Red Sokoto buck. The study revealed

that bucks with good body size and higher semen volume and quality exhibited less sperm morphology defects. Therefore, semen traits such as semen volume, sperm concentration and live/dead ratio; and body measurement such as body weight, body condition score, heart girth and height at-withers could be used to estimate semen quality in bucks, thereby ensuring the elimination of unqualified bucks before being used for breeding purposes.

Classical methods of semen evaluation generally measure sperm concentration, progressive mortality, the percentage of viable cells, and morphology. These assays may not be enough in predicting fertility outcome because only those samples with markedly poor quality semen can be identified. Among the most important aspect of the study on spermatozoa metabolism is the understanding of the chemical path ways involved in energy metabolism and maintenance of osmotic balance by ions present in semen which are important determinants of sperm viability.

Semen plasma is very important for sperm metabolism, function, survival, and transport in the female genital tract. Considerable attention is beginning to be paid to interrelationships of seminal cation to some measured traits that relate to semen quality in animals. Akpa et al.(2013e) therefore, studied the relationship between semen cation concentrations, semen characteristics, testicular measurements and body conformation traits in Red Sokoto goat. From the study bucks with adequate concentration of Ca exhibited better testicular dimensions; while bucks with good body structure showed high concentrations of K in seminal fluid, produced higher semen volume with increased sperm concentration and motility.

Body Growth and Measurements in Goat

Improvement of production performance in goats will require genetic improvement of their live body weight and linear body conformation. To achieve these goals, proper measurement of growth traits is required. Equally important is the need to understand the factors that influence them (Iyiola-Tunji et al., 2009). Also there is need to characterize the indigenous breeds of goats in Nigeria based on their body weight and linear body conformation. In a study conducted on smallholder Red Sokoto goat herds in five locations (Abuja, Jigawa, Katsina, Kano and Zaria) in the Northern Guinea

savanna zone of Nigeria, it was shown that the average body weight (BW), height at withers (HW), heart girth (HG) and body length (BL) were 23.56kg, 58.20cm, 66.38cm and 57.41cm, respectively (Table 5). The average BW of 23.56kg obtained in this study is within the range of 16-30 kg and 20-40 kg reported by Hassan and Ciroma (1990) and Osuhor et al., 2002, respectively in a composite herd population of both males and females of Red Sokoto goats. Also, the mean HW of 58.20cm is within the range of 56-67cm reported by Hassan and Ciroma (1990) and similar to the 58.2cm and 57.7cm reported by Ibrahim (2010). The mean HG of 66.38cm is within the range of 61-76cm reported by Hassan and Ciroma (1990) and comparable to the 65.0cm reported by Ibrahim (2010). However, the mean BL of 57.41cm obtained in this study was far below the range of 79-97cm reported by Hassan and Ciroma (1990). This variation could be as a result of differences in traits definition and measurements as well as population size.

Table 5: linear body conformation traits of Red Sokoto goats in different locations

Locations	N	Conformation traits			
		BW (kg)	HW (cm)	HG (cm)	BL (cm)
Abuja	94	21.60	57.70	62.40	-
Jigawa	1079	29.24	60.81	70.29	60.69
Katsina	1052	25.93	59.15	69.32	54.80
Zaria	821	20.65	58.95	64.10	55.10
Kano	1000	20.40	54.40	65.80	59.0
Overall	4046	23.56	58.20	66.38	57.41

BW=body weight, HW= height at withers, HG= heart girth, BL=body length

Attempts in evaluating the Red Sokoto goats, explored the influence of strain and sex on body weight (BW) and linear body measurements (body length, BL; height-at-withers WH; heart girth HG) and their relationships in six age categories (1-6, 7-12, 13-18, 19-24, 25-30 and 31-36 months) using 720 smallholder Red Sokoto goats of Nigeria (Akpa et al.,1998a). Sex significantly ($P<0.05$) influenced all body measurements at the given age categories with males weighing heavier and having wider HG than females; but females had longer and higher BL and HW. Kawu et al. (2006) equally observed sexual dimorphism in zoometrical traits of goats. Strain of Red Sokoto goat significantly ($P<0.01$) influenced the body measurements. Brown and light brown goats were

predominantly heavier in BW and had higher HW. Body weight was significantly ($P<0.01$) and positively correlated with BL, HW and HG and based on the magnitude of the correlations, HG and BL could be used to estimate BW of Red Sokoto goats across all ages. The constant ratios of BL: HG (10), BL: HG (0.9), and HW:HG (0.9) can be used to characterized the goats, irrespective of strain, sex or age, as belonging to the Red Sokoto goats of Nigeria.

The possible effects of parity, litter size and sex on kid body weight, growth rate and body linear measurements in Red Sokoto goats (Akpa, 2000) as a step towards employing them as correction factors in body weight estimation for selection purposes were evaluated using 240 kids born to 122 dams in Zaria. The average birth weight, heart girth, body length and height at withers was 1.2kg; 24.4cm and 26.3cm, respectively, and at 3 months of age was 5.5kg, 53.4cm, 53.7cm and 51.3cm, respectively. The 3 months average daily gain was 48g/d. Kids born singles weighed heavier than twins and triplets but with slower growth rate. Males weighed heavier than females. Litter size, sex and parity significantly ($P<0.05$) influenced 3 months body measurements but not at birth in Red Sokoto goat. Singles were superior to twins and triplets; but 1st parity kids were inferior to subsequent ones.

Furthermore, studies on the effect of parity on birth weight of Red Sokoto kids (Akpa et al., 2009; Akpa et al., 2011a), revealed that parity was one of the factors that exerted significant ($P<0.05$) influence on birth weight of the kids, with the concurrent increase in birth weight with parity up to the 5th parity and declined, indicating that beyond the 5th parity the birth weight of the kids might depreciate. This is contrary to the reports of Osinowo et al. (1994), and Awemu et al. (1999) in which, in their separate findings observed that body weight increased with parity, with the highest body weight occurring at the 6th parity. Such differences might be due to breeds and management differences. However, full reproductive capacity is not attained in any species at the first reproductive cycle, thus as parity increases kids are expected to mate and conceived readily. Therefore, available information on the parity level at which full reproductive efficiency is attained will help a lot in culling programme for dams of advanced parity level.

In another study, the effects of sex, month of kidding and dams' mating weight on birth weight, body weight and linear body

measurements at 1, 3, 6 and 9 month of age in small holder goats was evaluated (Akpa et al., 2010a). The effect of sex was significant (P<0.01) on the measured characteristics except on BL and CG at 9 month of age. The males were consistently heavier and bigger in size than the females from birth to 9 months of age, although the differences in BL and CG at nine months of age were not significant (P>0.05) (Table 6).

The mean values for male and female kid's body weight and linear body measurements increased in a similar manner from birth to 9 months of age, but with the highest rate of increase occurring within 3 months (12 weeks) of age. The rate of growth of kids from birth to 3 months of age was 2.01kg/ month, 2.03, 2.77 and 2.67cm/ month for BW, HW, BL and CG, respectively for males and 1.97kg/month, 2.03, 2.77 and 2.67cm/month.

Table 6: Effect of sex on birth weight, body weight and Body measurements at different ages in Red Sokoto kids.

Traits	N	Male	Female	LOS
Birth weight (kg)	1000	1.96±0.01^a	1.89±0.01^b	**
One month weight (kg)	1000	4.8±0.02^a	4.40±0.02^b	**
" " HW (cm)	1000	34.5±0.08^a	33.8±0.08^b	**
" " BL (cm)	1000	34.5± 0.14^a	33.00±0.14^b	**
" " CG (cm)	1000	37.7±0.09^a	35.8±0.09^b	**
Three month weight (kg)	1000	8.00±0.02^a	7.8±0.02^b	**
" " HW(cm)	1000	40.6±0.10^a	39.9±0.11^b	**
" " BL (cm)	1000	42.8±0.11^a	43.4±0.12^b	**
" " CG (cm)	1000	45.7±0.12^a	43.2±0.02^b	**
Six month weight (kg)	1000	10.7±0.02^a	10.3±0.20^b	**
" " HW(cm)	1000	45.6±0.20^a	45.5±0.09^b	**
" " BL (cm)	1000	46.8±0.09^a	48.0±0.09^b	**
" " CG (cm)	1000	50.1±0.09^a	48.0±0.09^b	**
Nine month weight (kg)	1000	13.3±0.02^a	12.8±0.02^b	**
" " HW(cm)	1000	50.8±0.10^a	48.5±0.10^b	**
" " BL (cm)	1000	54.8±2.08	51.2±2.08	ns
" " CG (cm)	1000	57.4±1.97	54.7±1.97	ns

a,b,c means within rows with different superscripts differ significantly (P<0.05)

* p<0.05, ** p<0.01, NS= not significant, HW=height-at withers, BL= body length, CG= chest girth

for BW, WH, BL and CG, respectively in females. Beyond this age (3 months) for the defined characteristics, growth was increasing at a decreasing rate up to the 9 months of age in which the average growth rate was 0.88kg/month, 1.70, 2.00 and 1.95cm/month for

BW, HW, BL and CG, respectively in males and 0.83kg/month,1.43, 1.30 and 1.92cm/month for BW, HW, BL and CG, respectively in females. Although such increase in the measurements with age is expected as the animal is developing but the developmental rate indicates that the highest development was at the pre-weaning which was almost twice that between weaning and 9 month of age. This suggests that the size of an animal at maturity will be dependent upon the developmental rate and the relationship between various body measurements at pre-weaning ages.

The observed high rate of increase in body weight and body dimension from birth to 3months of age, closely agreed with the result published by Taure and Meyer (1990), Bratte et al (1999) and Akpa et al. (2006a, b) in rams.

The superiority in body weight by males may be due to the fact that male fetuses grow faster during gestation and will have heavier weight advantage than the females (Gwaza et al., 2007). It may also be due to anabolic effect of androgen which is known to have growth and weight stimulating effect (Frandson, 1981).

Month of kidding had significant effect on birth weight ($P<0.01$) and body weight ($P<0.05$) at 1, 3, 6 and 9 months of age (Table 7). The variation due to month of kidding observed on birth weight and body weight of the kids to 9 months of age may be a reflection of the variations due to quality and quantity of pasture available for the does to feed on during the kidding period. It is logical to expect relationship between plane of nutrition of does and birth weight of kids. Thus, it may therefore, be necessary in small holder production system to design a breeding programme where by does kid toward the end of the dry season so as to benefit from the earlier rainy season nutritious pasture favorable for higher milk production, and optimum profitability as a result of rapid growth and heavier kids at birth and at weaning to later months.



Table 7: Effect of month of kidding on birth weight, body weight, and Body measurements at different ages in Red Sokoto kids

Traits	N	April	May	LOS
Birth weight (kg)	1000	1.9±0.01^{b}	2.09±0.01^{a}	**
One month weight (kg)	1000	4.5±0.02^{b}	4.60±0.02^{a}	**
" " HW(cm)	1000	33.6±0.09^{b}	34.3±0.09^{a}	**
" " BL (cm)	1000	33.5± 0.15^{b}	34.00±0.15^{a}	**
" " CG (cm)	1000	36.2±0.11^{b}	37.0±0.09^{a}	**
Three month weight (kg)	1000	7.60±0.02^{b}	7.9±0.03^{a}	**
" " HW(cm)	1000	40.1±0.11	40.2±0.11	ns
" " BL (cm)	1000	41.1±0.12	41.0±0.12	ns
" " CG (cm)	1000	44.9±0.13	44.7±0.12	ns
Six month weight (kg)	1000	10.5±0.02^{b}	10.7±0.20^{a}	**
" " HW(cm)	1000	44.9±0.13	44.1±0.09^{b}	ns
" " BL (cm)	1000	46.4±0.10	46.3±0.09	ns
" " CG (cm)	1000	48.1±0.11^{b}	49.70±0.09^{a}	**
Nine month weight (kg)	1000	12.6±0.02^{b}	13.5±0.03^{a}	**
" " HW(cm)	1000	49.9±0.12	49.8±0.10^{b}	ns
" " BL (cm)	1000	50.8±2.02	50.2±2.08	ns
" " CG (cm)	1000	54.7±1.97	55.2±1.90	ns

a,b,c means within rows with different superscripts differ significantly (P<0.05)

* p<0.05, ** p<0.01, NS= not significant, HW=height-at withers, BL= body length, CG= chest girth

The effect of dams' mating weight (DMwt) was significant (P<0.01-0.05) on all the measured characteristics except BL at one month of age, HW at 3 months of age, BL and CG at 9months of age. Birth weight increased with increase in dams' mating weight, this implies that dams with higher body give birth to heavier kids.

Despite the efforts of colonial authorities to preserve the purity of the Red Sokoto goats because of the commercial value of its skin, uncontrolled breeding among Nigerian goats is rampant, making breed classification increasing difficult. Therefore, a study was conducted to compare the zoometrical features of the Red Sokoto and West African Dwarf goats in three ecological locations with a view to determining the influence of breed and eco-zone on zoometrical differentiation of the major Nigerian breeds (Kawu et al., 2005). It was observed that with the exception of HW and shin circumference, the Red Sokoto goats in Zaria and Kano, WAD goats in Jos and Edo State maintained distinct head, limb and trunk zoometrical features. The similarity in HW and Shin circumference may be due to common ancestry and/ or uncontrolled crossbreeding.

Morphological Traits and Their Gene and Genotypic Frequencies in Red Sokoto Goat

Since characterization of a breed is the first approach to a sustainable use of animal genetic resource, studies on diversity and variability between indigenous goats on the basis of quantitative (morpho-structural) and qualitative (morphological) variables is very important. Thus, data from smallholder flocks of Red Sokoto goats (n = 888) randomly sampled in Katsina, in the Northern parts of Nigeria were used in 2010 to investigate the distribution frequencies of certain qualitative traits (Ijomanta, 2012). The animals were scored for the presence or absence of wattle, beard, horn, coat-colour and hair type (smooth or coarse).

The five qualitative traits (Wattle, Beard, Horn, Coat colour and Hair type) were used as classification variables. On the basis of incidence of wattles, animals were categorized into wattled (Waw) and non-wattled (Wa+) goats, presence (Brb) or absence (Br+) of beard, presence (Ho+) or absence (Hop) of horn and also for the presence (Stt) or absence (S+) of supernumerary teats. They were also scored for the head profile; sub-convex (Hpsv) or straight (Hpst) head profile. Goats were also assessed according to coat colour. The distribution of the various traits were expressed in percentages and categorized according to sex. The frequencies of the recessive alleles (Wa+, Br+, Ho+ S+ and Hpst) were estimated using Hardy-Weinberg equilibrium equation as shown below:

$$q = \sqrt{\frac{m}{M}}$$

Where, q = frequency of the recessive gene; m = observed number of animals exhibiting the particular recessive trait; M = total number of animals sampled. From q above, the frequencies of the dominant alleles (Waw, Brb, HoP , Sttand Hpsv) were calculated as follows: p = 1-q

Where, p = frequency of the particular dominant allele. The observed frequencies were tested against the expected Mendelian ratio of 3:1 corresponding to values of 0.75 for the dominant allele and 0.25 for the recessive allele using Pearson's chi-square test. The null hypothesis (Ho) was that the population is in Mendelian

proportions. Genetic distance between the goats at different locations was estimated at the wattle, beard, head profile and supernumerary teats loci using gene frequencies as follows:

$$d2 = (P1-P2)2$$

Where, d2 = genetic distance estimate between the two populations; P1 = gene frequency of population 1; P2 = gene frequency of population 2. The results showed that both sexes of Red Sokoto goats were wattled, beard and horned but at different frequencies (Table 8). The frequency of wattles (Waw) was very low (8%), however the wattle condition existed at a higher percentage for females (86%) than the males (14%). This was at variance to what was observed (Yakubu et al.,2010) in WAD goats, in which relatively higher proportion was observed in male (31.64%) than in female WAD goats (5.78).

As in the wattle, possession of beard was evident in both sexes. However, there was sexual dimorphism in its distribution, as more females (0.65%) exhibited the trait than males (0.35%). This is in contrast to the earlier findings of Yakubu et al., (2010) in which he reported higher preponderance of beard in males (33.33%) of Red Sokoto and (18.64%) of WAD goats than females (6.49 and 4.00% for Red Sokoto and WAD goats, respectively). The sexual difference observed is not unexpected since the occurrence of beard is due to a locus which is dominant in males and recessive in females. It is a secondary sexual characteristic under male hormonal action; thus, females displaying the trait are likely to have threshold levels of androgenic hormone (Yakubu et al.,2010). All the goats were horned (Ho+) regardless of sex (100% in each case).

WAD goats than females (6.49 and 4.00% for Red Sokoto and WAD goats, respectively). The sexual difference observed is not unexpected since the occurrence of beard is due to a locus which is dominant in males and recessive in females. It is a secondary sexual characteristic under male hormonal action; thus, females displaying the trait are likely to have threshold levels of androgenic hormone

(Yakubu et al.,2010). All the goats were horned (Ho+) regardless of sex (100% in each case).

Table 8 : Frequency (%) of the qualitative traits of Red Sokoto goats according to sex

Traits	Alleles	N	Frequency distribution		Polled
			Male	Female	
Wattle	Wa^{w}	71	0.14	0.86	8
	Wa^{+}	817	0.09	0.91	92
Beard	Br^{b}	170	0.35	0.65	19
	Br^{+}	718	0.03	0.97	81
Horn	Ho^{p}	0	0.00	0.00	0
	Ho^{+}	888	0.09	0.91	100
Head profile	Hp^{s}	24	0.72	0.28	3
	Hp^{sv}	864	0.07	0.93	97

Wa^{w} = wattled; Wa^{+} = non wattled; Br^{b}= presence of beard; Br^{+}= absence of beard; Ho^{p} = polled; Ho^{+} = horned; Hp^{st} = straight; Hp^{sv} = Sub-convex; St^{t} = presence of supernumerary teat; St^{+} = absence of supernumerary teat

The Red Sokoto goats have various colour patterns that are obvious; these colours are dark red, brown and light brown. In a survey conducted in four locations (Abuja, Jigawa, Katsina, Zaria) within the Northern Guinea Savanna zone in 2010 and 2011, where the breed is predominant (Fig 1-4, Table 9),it was revealed that in Zaria (n=821), the distribution of the Red Sokoto goats with dark brown colouration was higher (46.89%) than those with either red (32.89%)or light brown (14.62%) colouration. In Katsina, (n= 888) majority of the goats were brown (46.62%) followed by light brown (25.0%) and the least was dark red colouration (6.98%). Also in Abuja, (n=94), goats with brown colouration were in the majority (68.09%).

The apparent wide variation in coat colour is an indication that the goat populations have not been purified through impeccable selective breeding. Therefore, great opportunities exist for their improvement. One of the possibilities as postulated by Toth et al. (2006), is to design selection towards specific coat colour putting into cognizance the relationship between polygenetic effects of coat colour and other traits of interest (for example, physiology, morphology and productivity).

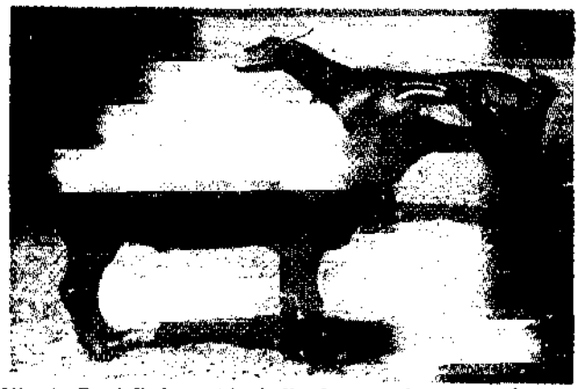


Fig 1: Red Sokoto/dark Red smooth coat colour

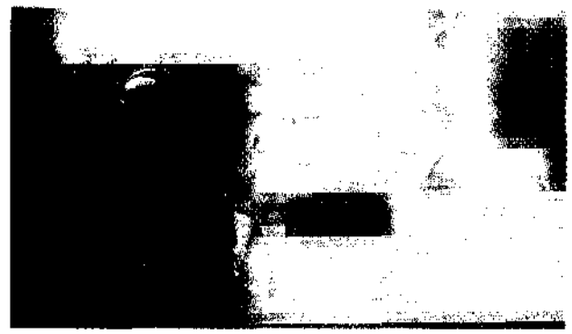


Fig. 2: Red Sokoto/brown coat colour



Fig 3: Red Sokoto goat /light brown coat colour

Structurally, majority of the Red Sokoto goats have short smooth hair (69.8%), followed by short rough hair (18.40%) and

long curly hair (11.8%), respectively. The preponderance of smooth hair structure could be an advantage as it provides a medium for convectional heat loss from the animal surface. This is supported by the assertion that hair structures have an important role to play in the adaptability of animals to different ecological zones (Banerji, 1984). Conclusively therefore, there are variations in the coat colour of the Red Sokoto goat with the predominant coat colour as brown; other common colours are light brown and dark red. The predominant hair type is short smooth hairs.

Table 9: Distribution of coat colour in smallholder goat herds in different locations

Location	N	Coat Colour			
		Dark Red	Brown	Light Brown	Others
Zaria	821	270 (32.89)	385(46.89)	120 (14.62)	46(5.60)
Katsina	888	62 (6.98)	414 (46.62)	222(25.00)	190(21.39)
Abuja	94	-	64(68.09)	21(22.34)	9(9.57)
Pooled	1803	323(18.41)	863(47.86)	363(20.13)	245(13.59)

Figures in parenthesis are percentages, i= goats with other colours other than the one listed



Plate 4: Light brown goat with rough hair type

The distribution of goats according to head profile in association with sex and coat colour is shown in Table 10. The head profile was strongly ($P<0.01$) associated with sex of the goats, but

independent of the coat colour. The sub-convex head profile was more peculiar to females than the males, while the sub-concave head profile was associated with the males than the females. Although there was no literature found that relates this observation, but this may probably be linked to the influence of secondary sex hormones on the development of both the males and females.

Table 10: Distribution of goats according to head profile in association with sex and coat colour

Attributes	Head profile	
	Sub- convex	Sub- concave
Sex		
Male	0	42
Female	75	3
X^2 value= 89.5; Table value at 1%= 6.63; df=1;**		
Coat colour		
Dark brown	**59**	17
Brown	17	12
Black	6	9
X^2 value = 5.96; Table value at 5% = 5.99; df =2; ns		



Plate 5: Brown with white spotted coat colour

A study was conducted in 2010 to morphologically characterize the Red Sokoto goat in Zaria and its environs. The study utilized records from 500 goats aged from 1 to 5 years and gave the following results: sub concave (94.4%) and sub convex (5.6%) head profile; small (61.8%) and medium (38.2%) ear size;

rigid ear consistency (100%); presence of horn (100%) in both sexes; vertically backward (88%); vertically backward and curved forward (11.4%) and arched (0.6%) horn types; raspil and calzon (61.6%); long (19.2%); and short (19.2%) hair types; and majorly non-wattled (96%). When wattled, it occurred bilaterally (85%) and unilaterally (15%) and non-paired. The observed coat colours in these goats were dark red (49.2%), brown (48.6%) and black (2.2%). The skin colour was predominantly brown (99.2%) with black in rare occurrence (0.8%). In another study on the incidence of wattle in 2011, 948 goats from 104 herds from northern and central plateau were used. Wattle incidence was (37.45%). Dams with wattle had (45.3%) chances of expressing it in their offsprings.

Gene Frequency of Qualitative Traits in Red Sokoto Goat.

The gene frequencies of observed qualitative traits in Red Sokoto goat are shown in Table 11. Frequencies of the dominant alleles for Red Sokoto goats was 0.04 (Waw), 0.11 (Brb),0.00 (Hop), 0.02 (Hpst) and 0.13 (STt). These values were quite lower than the expected Mendelian value of 0.75. However, higher frequencies were observed for the recessive alleles The P-value was highly significant ($p<0.01$).

Table 11: Gene frequencies of the observed qualitative traits in Red Sokoto Goats

Traits	*Alleles*	*Expected*	*Observed*	*Gene freq.*	*LOS*	χ^2*test*
Wattle	Wa^w	222	71	0.04	**	633.63
	Wa^+	666	817	0.96		
Beard	Br^b	222	170	0.11	**	343.67
	Br^+	666	718	0.89		
Horn	Ho^p	222	0	0.00	**	0.00
	Ho^+	666	888	1.00		
Head profile	Hp^s	222	24	0.02	**	808.79
	Hp^{sv}	666	864	0.98		
Supernumerary teats	St^t	202.8	195	0.13	**	221.00
	St^+	608.2	616	0.87		

Wa^w = wattled; Wa^+ = non wattled; Br^b= presence of beard; Br^+= absence of beard; Ho^p = polled; Ho^+ = horned; Hp^{st} = straight; Hp^{sv} = Sub-convex; St^t = presence of supernumerary teat; St^+ = absence of supernumerary teat

Table 12 shows the gene frequencies of the observed qualitative traits in Red Sokoto goats according to location and coat colour. Frequencies of the dominant allele ranged between 0.02 to

0.06 (Waw) for zones and 0.04 to 0.07 (Wa+) for coat colour. The gene frequencies observed generally for the dominant alleles at different zones and for coat colour ranged between 0.00 to 0.12, while higher frequencies (0.89 to 1.00) were recorded for the recessive alleles at the various zones and different coat colours for wattle, beard, horn and head profile. The observed frequencies of supernumerary teat (STt) on Red Sokoto goats was 0.08, 0.18 and 0.13 for Katsina, Daura and Malumfashi respectively while that of the coat colour was 0.31, 0.12, 0.21, and 0.12 for brown, light brown dark red and mixed colour, respectively.

Table 12 :Gene frequencies of the observed qualitative traits in Red Sokoto goats according to zone and coat colour

Traits	Alleles	N	Locations			Coat colour			
			Kat	Daura	Mal	BR	LB	DR	Mixed
Wattle	wa^w	71	0.04	0.02	0.06	0.04	0.04	0.07	0.04
	Wa^+	817	0.96	0.98	0.94	0.96	0.96	0.93	0.96
Beard	Br^b	170	0.10	0.09	0.11	0.09	0.11	0.08	0.12
	Br^+	718	0.90	0.91	0.89	0.91	0.89	0.92	0.88
Horn	Ho^p	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Ho^+	888	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Head	Hp^{st}	24	0.02	0.01	0.01	0.01	0.01	0.01	0.03
profile	Hp^+	864	0.98	0.99	0.99	0.99	0.99	0.99	0.97
Sup.	ST^t	195	0.08	0.18	0.13	0.13	0.12	0.21	0.12
Teats	ST^+	616	0.92	0.82	0.87	0.87	0.82	0.79	0.88

Sup. teat= supernumerary teat; BR (brown); LB (light brown); DR (dark red); Wa^w = wattled; Wa^+ = non wattled; Br^b=presence of beard; Br^+= absence of beard; Ho^p = polled; Ho^+ = horned; Hp^{st} = straight; Hp^{sv} = Sub-convex; St^t = presence of supernumerary teat; St^+ = absence of supernumerary teat; Kat=Katsina; Malf=Malumfashi



Matrix of Genetic Distance of Red Sokoto Goat by Zone and Coat Colour

The estimated genetic distance of Red Sokoto goats between Katsina and Daura (Table 13) were 0.0004, 0.0001, 0.0001 and 0.0001 at the wattle, beard, head profile and supernumerary teat loci, respectively and 0.0004, 0.0001, 0.0004 and 0.0025 for Kastina and Malumfashi, while the genetic distance estimated for the qualitative traits in Daura and Malumfashi was 0.0002 (wattle), 0.0004 (beard) and 0.0025 (supernumerary teat). Genetic distances make it possible to evaluate the degree of genetic similarity between two populations by measuring the probability of one or more characters appearing in one of the populations but not in the other (Sournia, 1991). The minuscule values obtained at the Wa, Br, Hp and ST loci of goats are indications of phylogenetic relationship between the RSG at different location and is indicative of genetic similarity amongst the population of the RSG in these locations.

Table 13: **Matrix of genetic distance of Red Sotoko goats by locations**

Traits	Katsina vs Daura	Katsina vs Malumfashi	Daura vs Malumfashi
Wattle	0.0004	0.0004	0.0002
Beard	0.0001	0.0001	0.0004
Head profile	0.0001	0.0001	-
S/teats	0.001	0.0025	0.0025

S/teats= Supernumerary teats

Table14 shows the matrix of genetic distance of Red Sokoto goats by coat colour. The estimated genetic distance at the beard locus ranges between 0.0001 and 0.0016. At the wattle locus, the estimate observed was 0.0009 for BR and DR; LB and DR and DR and mixed colour patterns. The estimated genetic distance at the head profile locus for BR and mixed, LB and mixed, DR and mixed was 0.004 while that observed at the supernumerary teat locus ranged from 0.0004 to 0.0081.

Table 14:Matrix of genetic distance of Red Sokoto goats by colour

Traits	BR vs LB	BR vs DR	BR vs Mixed	LB vs DR	LB vs mixed	DR vs mixed
Wattle	-	0.0009	-	0.0009	-	0.0009
Beard	0.0004	0.0001	0.0009	0.0009	0.0001	0.0016
Head profile	-	-	0.0004	-	0.0004	0.0004
S/Teats	0.0004	0.0064	0.0004	0.0081	-	0.008

BR (brown); LB (light brown); DR (dark red); S/teats= Supernumerary teats

Blood Biochemical Polymorphism In Goats

Blood and blood components are undoubtedly essential biological characteristics and warrant consideration for the study of a breed. Studying the hematological picture is helpful for clinical diagnostics, but it is also essential to reflect the particular evolution of a breed or a population; actually, the fact that some blood factors are related to the suitability of the breeds under particular environmental conditions has been repeatedly suggested (Tibbo et al.,2005; Essein et al.,2011).

In the recent times, advances in the field of biotechnology has opened up a completely new area at molecular levels with the introduction of techniques such as routine electrophoresis employed for the detection of polymorphism at protein and enzyme loci as well as other serological and immunogenetic procedures for the measurement of variation(Salako et al., 2007). Hemoglobin (Hb) has been one of the most studied polymorphisms in vertebrate species since the infancy of both population and evolutionary genetics. However, owing to the close relationship between structure and function, this complex protein remains a fascinating subject from all points of view and especially in terms of its molecular, genetic and adaptive features.

The electrophoretic analysis of blood sample collected from goats at different locations in Abuja and Zaria and Katsina, Kano

and Jigawa States showed the presence of 3 haemoglobin genotypes; AA, AB and BB (Table 15, Plate 7). These 3 haemoglobin genotypes were produced by two co-dominant alleles HbA and HbB. However another allele HbC was detected (in association with the HbA allele to form HbAC genotype) at very low frequency, mostly in kids of between 1 to 12 months of age (Akpa et al., 2011c; Ibrahim et al., 2011; Alphonsus et al., 2012; Sam et al., 2012b). This HbC allele had earlier been reported by Salako et al.(2007) in the same breed (Red Sokoto goats) and Deza et al.(2000) in the goats of Colon and Ischlin, and this has been variously associated with incidence of anemia due to illness environmental stress in small ruminants. However, some studies identified HbC allele as foetal haemoglobin in very young kids and may not necessarily be an incidence of anemia or illness especially in the kids of less than 6 months of age. It can however indicate abnormality if it persist in high percentage beyond the neonatal age.

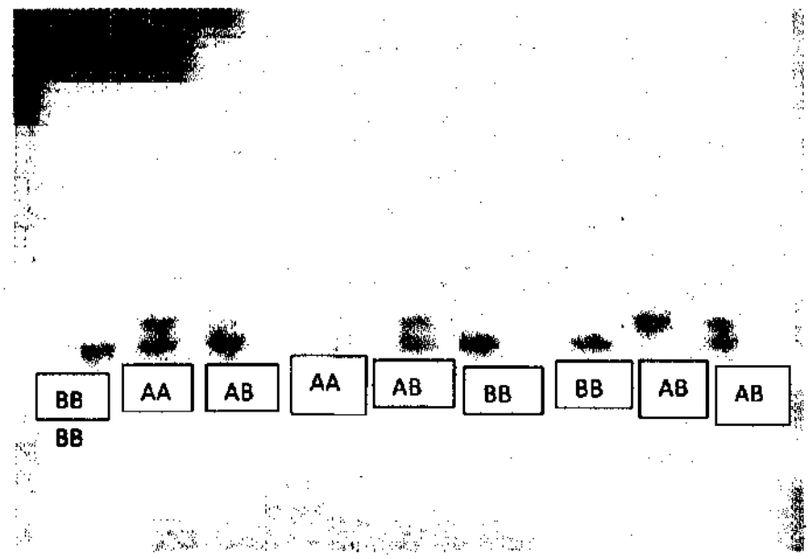


Plate 7: Haemoglobin electrophoregram in goats.

The frequency of the heterozygote haemoglobin type HbAB was higher than either of the homozygotes; HbAA and HbBB in all the four locations.

However, the preponderanceof HbA alleles was about twice that of the HbB allele; Abuja (0.66 vs 0.34), Jigawa (0.68 vs 0.32), Katsina (0.59 vs 0.41) and Zaria (0.60 vs 0.40).The similarity in the distribution pattern of the Hb-type in the four locations is probably due to similarity in topography and climatic condition, all the 4 locations of the study are situated on the high altitude of the Northern guinea savanna of Nigeria. However, this observation was at variance with the earlier report of Salako et al.(2007), who reported higher frequencies of HbB alleles than HbA allele in goats at their respective locations of studies. This variation is probably due to differences in the topographical locations; their studies were on goats at low altitudes of Bengal India (altitude 42fts above sea level) and Ibadan Nigeria (altitude 780fts above sea level), respectively, while the present study was conducted at the high altitude of Abuja(2552fts above sea level), Katsina (1525ft above sea level) and Zaria (2251ft above sea level) in Nigeria.

The high preponderance of heterozygotes with intermediate heredity (AB) than either of the homozygote (AA or BB) usually indicates the proportion of heterozygotes in a random mating population. The similarity in the estimated heterozygotism in all the four locations studied therefore, suggests that proportions of heterozygotes in the samples were similar although the significance of the difference was not tested. It has a clear biological meaning as it can be regarded as the measure of genetic diversity at the hemoglobin locus in the investigated populations; hence showing that the studied populations have similar flock structure and mating pattern.

Table 15 : Gene and genotypic frequencies of haemoglobin (Hb) types in goats at different locations

Location	Sample size	Gene frequencies		Genotypic frequencies		
		HbA	HbB	HbAA	HbAB	HbBB
Abuja	94	0.66	0.34	0.36	0.48	0.16
Jigawa	150	0.68	0.32	0.43	0.50	0.07
Katsina	150	0.59	0.41	0.37	0.48	0.17
Zaria	211	0.60	0.40	0.36	0.48	0.16
Overall	605	0.63	0.37	0.38	0.48	0.14

The distribution of Hb-types in the study area was found to be independent of age, coat colour and head profile of the goats (Table 16). However, the foetal Hb AC was mainly observed in the young goats that were within one year of age (83%) and non beyond 2 years of age. This is in line with the report of Brandis (2000) that at birth about 80% of the neonate's haemoglobin is foetal

haemoglobin (Hb C) , this decreases rapidly so that by the age of 6 months less than 5% of the young's haemoglobin is HbC. Only very small amounts of Hb C are normally present in adults (<1% of total haemoglobin in adults).

Table 16: Distribution of goats according to haemoglobin types in association with age, coat colour and head profile

Age (months)	**AA**	**AB**	**BB**	**AC**
12	20	10	25	12
18	14	4	13	1
24	5	2	9	1
30	0	0	4	0
X^2value = 12.71; df= 9, Table value at 5% = 16.92; ns				
Coat colour				
Dark brown	26	11	30	9
Brown	10	4	13	2
Black	3	4	5	3
X^2 value= 6.17; df=6; table value at 5% =12.59; ns				
Head profile				
Sub concave	15	9	18	3
Sub convex	26	10	29	11
X^2 value=1.83; df=3; table value at 5%=7.81; ns				

Researchers had identified the existence of different types of potassium (K) in different species of animals, and that in sheep for instance, there are two types of K which is high potassium (HK) and low potassium (LK) with the LK type dominant over the high K type (Soysal et al.,2003). Also Gurcan et al (2010) reported a range of 4.23 to 11.69mmol/l for low K type in animals. In view of the forgoing, a study was conducted to investigate the type and concentration of potassium (K) in the blood of the Red Sokoto goats population in Katsina and Jigawa States. The study revealed the existence of two types of K in the goats, as high potassium (HK) and low potassium (LK) with the LK type dominant over the HK type (Table 17)

Table 17: Gene and Genotypic Frequencies of potassium types of Goats in Jigawa and Katsina States

Population	No of Animals	Gene Frequencies		Genotypic Frequencies	
		HK	LK	K^H	K^L
Overall	250	0.84	0.16	0.91	0.01
Katsina	100	0.83	0.17	0.91	0.01
Jigawa	150	0.85	0.14	0.92	0.01

The gene frequencies for the HK and LK were 0.844and 0.156, respectively, while the genotypic frequencies for the HK and LK types were 0.91 and 0.01, respectively (Table 17). This finding is in agreement with the reports of Cobanoglu et al. (2011) that the allele frequencies 0.80 and 0.20; 0.85 and 0.15; 0.87 and 0.13 for HK and LK respectively was observed in Saanen, Maltase and Turkish Hair goats, respectively in Turkey. Although LK type was dominant to its counterpart HK genetically but majority of the animals in the population studied were HK type. This observation was earlier reported by other authors (Al-Samarrae and Younis, 2011). A study was conducted in 2013 to define the genetic structure for haemoglobin, transferring and carbonic anhydrase using 300 goats each for Red Sokoto, Sahel and West African dwarf (WAD). The result showed that the three blood proteins were polymorphic across the breeds (Table 18). The polymorphic forms were haemoglobic (AA, AB, AC and BB), transferring (AA, AB, AC and BB) and carbonic anhydrase (FF and *SS*).

Table 18: Gene and Genotypic Frequencies of blood biochemical polymorphisms in Nigerian goat breeds.

Polymorphic Traits		Red Sokoto	Sahel	West African Dwarf
Haemoglobin (Hb)				
Gene Frequencies Hb A	Hb	0.41	0.55	0.43
Hb B		0.58	0.43	0.55
Hb C		0.01	0.02	0.02
Genotypic Frequencies Hb AA	Hb	0.23	0.39	0.23
Hb AB		0.31	0.38	0.30
Hb AC		0.01	0.02	0.02
Hb BB		0.45	0.21	0.45
Transferring (T_f)				
Gene Frequencies A	T_f	0.39	0.37	0.41
B	T_f	0.13	0.56	0.12

	T_f	0.48	0.07	0.47
C				
Genotypic Frequincies	T_f	0.13	0.22	0.13
AA				
	T_f	0.22	0.54	0.19
AB				
	T_f	0.53	0.11	0.55
AC				
	T_f	0.12	0.13	0.12
BB				
Carbonic anhydrase (C_A)				
Gene Frequencies		0.98	0.98	0.98
$C_A F$				
		0.02	0.02	0.02
$C_A S$				
Genotypic Frequencies		0.99	0.99	0.99
$C_A FF$				
		0.01	0.01	0.01
$C_A SS$				

Adaptive and Blood Biochemical Characteristics and Factors Affecting Them in Goats

Economic pressures of various kinds are forcing the production of livestock into climatic environments that are increasingly more remote from the considered ideal for optimal production and feed utilization. Thermal stress, which is one of the major factors that affect the productivity of many farm animals can be reflected in an easily observable changes in pulse rate, respiration rate, and rectal temperature. The most obvious index of thermal stress is body temperature response. Deviation from normal rectal temperature indicates that the animal is under stress, that its homeothermic mechanisms are compromised.

Adaptive characteristics of animals serve as a key to managing any livestock operation. Adaptive traits such as rectal temperature, heart rate, and flank movement have been documented to have some significant effect on genetic variations. Every normal animal has a range of individual adaptive traits in relation to a specific physiological pattern.

A work aimed at studying the effects of Haemoglobin type, sex and age on adaptive and blood biochemical characteristics of Red Sokoto goats was conducted (Akpa et al., 2013a, b) using 94 smallholder goats herd in Abuja, Nigeria showed that rectal

temperature (RT) is directly affected by the surrounding and ambient temperature, and high ambient temperature has a negative effect on productivity of the animal. The mean RT of the goats used for the study was 38.9oC with minimum and maximum body temperature of 38.1 and 39.4oC (Table 19). These values were within the reference range of goats in thermal neutral condition, thus indicating that the goats used for this research showed no clinical signs of stress during the research period. The body temperature of the goats exhibited minimal variations (CV=0.5%), thus implying that goats are homoeothermic animals, they can maintain near constant body temperature under wide range of environmental conditions.

The Heart Rate (HR) is the pulse that helps to know the beating rate of the heart which is measured in beats per minute (bpm) using stethoscope. The mean HR of the goats used in the study was 76.1 bpm, with the min and max HR of 70 and 80bpm. This is slightly higher than the range of 70 -75bpm reported by Derman and Noaks (1994) in goats. The minor difference observed in the values of the HR may be explained by differences in geographical conditions, season or climate and physiological conditions of the sample goats.

Rectal temperature and heart rate have shown to be good indicators of the thermal stress and may be used to assess thermal adversity of the environment (Al- Haidary, 2004).

Table 19: Summary Statistics of the measured characteristics in Red Sokoto Goats

Characteristics	N	Mean±SE	CV(%)	Min	Max
Rectal Temperature (°C)	94	38.9±0.02	0.5	38.1	39.4
Heart Rate (bpm)	94	76.1±0.39	3.8	70.0	81.0
Adaptive coefficient	94	4.3±0.02	5.0	4.1	4.6
Albumin concentration (g/l)	94	38.4±0.34	8.5	31.0	48.0
Hemoglobin concentration (g/dl)	94	8.9±0.16	17.1	4.0	12.7
Potassium concentration (Mmol/l)	94	4.0±0.06	14.7	3.0	5.8

Potassium is one of the intracellular elements that regulate the intracellular density of the cell. The amount of K-concentration is fairly high at intracellular membranes (Gurcan.,et al 2010). Relating the adaptive and blood biochemical characteristics of the

goats with their haemoglobin types, sex and age of the goats, it was observed that the variation of Hb type with adaptive and blood biochemical characteristics was significant (P<0.05) except Hb-concentration (Table 20). The relationship between Hb types and HR can be linked to the different levels of oxygen carrying capacity of the different Hb types. In this study, higher HR was observed in goats with Hb AA and AB, and Hb A is known to be the haemoglobin allele with highest affinity for oxygen. This is in line with the earlier report of Huisman et al.(1959) who related the preponderance of Hb A to it's greater affinity to oxygen. This could also explain the high adaptive coefficient observed on goats with Hb types AA and AB since adaptive coefficient is a function of HR and RT. The Adaptive Coefficient (AC) (which is the function of RT and HR) signifies the level of adaptability of the goats to the environments varied significantly (P<0.05) with Hb types , sex and age of the goats. The goats with Hb AA and AB had higher AC than those with BB and AC; likewise the bucks had higher AC than the does.

Table 20: Effect of hemoglobin type on adaptive and blood biochemical characteristics

Characteristics	Haemoglobin types				
	AA	BB	AB	SEM	LOS
Rectal Temperature (°C)	39.0^{a}	39.0^{a}	39.0^{a}	0.02	*
Heart Rate (bpm)	76.6^{a}	75.3^{b}	76.2^{a}	0.40	*
Adaptive coefficient	4.4^{a}	4.3^{b}	4.4^{a}	0.02	*
Albumin concentration (g/l)	37.6^{b}	39.2^{a}	38.6^{a}	0.34	*
Hemoglobin concentration (g/dl)	9.1	8.6	8.8	0.16	Ns
Potassium concentration (Mmol/l)	3.8^{b}	3.9^{a}	4.0^{a}	0.06	*
Number of observations	30	11	41	94	

The variation of HR, AC and Albumin concentration with sex was highly significant (P<0.01; Table 21). The RT of the buck and does were similar however, the HR was higher in bucks (78.5bpm) than the does (75.0bpm) This is probably due to the high sexual activity of the bucks. There was no significant (P>0.05) difference between the bucks and does in Hb and K concentration. Haemoglobin type had been reported to vary with breed and location (Abdussamad et al., 2004; Essien et al., 2011).

Table 21: Effect of Sex on adaptive and blood biochemical characteristics

Characteristics	Sex		SEM	LOS
	Buck	Doe		
Rectal Temperature (°C)	39.0	39.0	0.03	Ns
Heart Rate (bpm)	78.5[a]	75.0[b]	0.49	**
Adaptive coefficient	4.4[a]	4.3[b]	0.02	**
Albumin concentration (g/l)	39.8[a]	37.7[b]	0.49	**
Hemoglobin concentration (g/dl)	9.1	8.7	0.26	Ns
Potassium concentration (Mmol/l)	3.9	4.0	0.08	Ns
Number of observations	30	64	94	

[ab]: means within the same row with different superscripts differ significantly(P<0.01); :not significant;

Age significantly (P<0.05) influenced HR, AC and albumin concentration but had no significant influence on the RT, Hb and K concentration (Table 22). Although there was no trend in the variation of HR and AC with age, but it was observed that the HR and AC was higher in the older goats than the younger, however the albumin concentration significantly decreased with progressive increase in age of the goats.

Table 22: Effect of Age on adaptive and blood biochemical characteristics

Characteristics	Age of goat				SEM	LOS
	12mon	18mon	24mon	30mon		
Rectal Temperature (°C)	39.0	39.0	39.0	39.0	0.02	Ns
Heart Rate (bpm)	77.1[b]	74.4[c]	74.4[c]	78.5[a]	0.37	*
Adaptive coefficient	4.4[b]	4.3[c]	4.3[c]	4.5[a]	0.02	*
Albumin concentration (g/l)	39.2[a]	37.4[b]	36.7[c]	36.5[c]	0.32	*
Hemoglobin concentration (g/dl)	9.1	8.7	8.3	8.5	0.16	Ns
Potassium concentration (Mmol/l)	4.0	4.0	4.0	4.0	0.06	Ns
Number of observations	55	25	12	2	94	

[ab]: means within the same row with different superscripts differ significantly(P<0.05); ns: not significant;

The influenced of zone, breed, sex and age on adaptive characteristics of goat was studied using 929 goats in Jigawa State. The mean rectal temperature, heart rate and adaptive coefficient of goat were 38.6±0.02°C, 72.3±0.17bpm and 4.2±0.01, respectively. The characteristics were less variable (CV=1.45-7.12%). Zone, sex and age of the goat significantly (p<0.01) influenced the adaptive characteristics. However, breed of the goats (Sahel, Red Sokoto, West African dwarf and crosses) had no effect on them. The heart

rate and adaptive coefficient were higher for north east zone compared to north west and central zone of Jigawa state which were similar. On the other hand, rectal temperature decreased from north west (38.7°c) to north east (38.5°c) and central zone (38.4°c) of the state. Males had higher rectal temperatures, heart rates and adaptive coefficients than females; and these characteristics decreased with age in the studied goats.

Milk Yield, Composition and Estimations in Goats

Nigeria is endowed with large numbers of small ruminants, which are yet to be fully investigated for milk production. Goats are the largest group of ruminant livestock in the country, totaling over 38 million; predominantly owned by the rural households, with ownership spread across all age groups and sexes. The development of the Nigerian dairy goats will require a critical evaluation of all the locally available breeds and their potential for milk production. A number of studies have been carried out on the milk yield and composition of indigenous breeds of goats (Ehoche and Buvenandran, 1983; Akpa et al., 2005; Akpa et al., 2012) and products (Akpa et al., 2011d). Generally the milk yield of the does drops after a few weeks and becomes negligible by 15th week (Ngere, 1985). These reports emanated from universities and research centers; there is no information regarding on-farm milk production. Therefore, the milk yield characteristics of smallholder agro-pastoral Fulani Red Sokoto goats were evaluated using records obtained from a total of 92 does in 6 herds, collected over a 2 year period (Akpa et al., 2002a). The result indicated that the total yield was 79.8kg, daily yield 0.66kg, peak yield 1.21kg and day of peak production 28.7 day of lactation (Table 23)

Table 23: Least squares means for lactation milk yield characteristics of Red Sokoto goats

Characteristics	Mean	SD	CV (%)
Initial yield(kg)	0.946	0.432	45.7
Peek yield (kg/day)	1.209	0.661	54.7
Peak day	28.704	20.035	69.8
Total yield (kg)	79.827	30.813	38.9
Daily yield (kg/day)	0.664	0.258	38.6
Day 120 yield (kg/day)	0.432	0.192	44.4

The milk yield characteristics of Red Sokoto goats were highly variable with a coefficient of variability of 38.6 to 69.8%. The milk yield characteristics were significantly (P<0.01-0.05) influenced by herd, season, parity and litter size of the dam. Highly positive and significant (P<0.01) correlations(r= 0.66-0.99) existed between the total yield and the average daily yield, peak yield, initial yield and 120 yield. A negative and significant (P<0.05) correlation (r= -0.33) was observed between the peak day and initial yield. The non-homogeneity of the milk yield characteristics in Red Sokoto goats suggests the possibility of improving their daily production by selection of high yielding does. Selection for higher initial milk yield may improve other milk yield characteristics.

The goat is generally known to produce relatively more milk per unit of live weight compared to the cow. Also, as dairy animal, the doe is known to produce three times as much milk as the cow (Wilson, 1988), relative to body size. It has been reported that once daily milking could reduce fixed cost and may be used strategically as a quota management tool and could become the production system of choice in a programme intensification (Christopher and Richard, 1994). However, there is ample evidence to show that milking thrice or four times daily increased milk yield relative to once or twice daily milking, and once daily milking reduces milk yield in comparison to higher frequencies. (Carruthers and Copeman,1990). Therefore, the effect of milking frequency on milk yield characteristics (total yield, average daily yield, peak day, flow rate, dairy merit and persistency) of Red Sokoto goats was carried out (Akpa et al., 2004b). Thirty (30) lactating does were divided into three groups on milking frequency basis of once, twice and thrice a day milking of 10 animals each. All the does were at the 3rd lactation and were hand milked for a period of 120 days post-partum.

While milking frequency significantly (P<0.05) influenced total yield, average daily yield, peak yield and milk flow rate, did not affect peak day, dairy merit and persistency of these goats (Table 24). The milk yield characteristics increased with increase in milking frequency. Conversely, increase in milking frequency decreased milk flow rate.

The observed corresponding incremental effects of milking frequency on milk yield characteristics have been reported by

several other workers (Erdman and Varner, 1995; Barpeled et al., 1995). As was observed by Barpeled et al. (1995), the main effect of milking frequency on milk yield was directly related to the actual milk removal from the udder, regulated by the presence of protein in the milk that inhibits milk secretion and the feedback inhibitor of lactation (FIL). As milk accumulates in the udder between milking, secretion rate gradually decreases because of the action of FIL.

More frequent removal of milk from the udder enables a longer maximal secretion rate than less frequent one, causing milk to accumulate in the udder between milking, leading to gradual decrease in milk secretion rate due to the FIL effect. Therefore, milking frequency is extrinsic in action; thus explaining why it had no influence on peak day, dairy merit and persistency which are intrinsic properties of the does that are less subjected to extrinsic influences.

Since labour for milking harvest accounts for as much as 80% of animal milking cost (Blake and McDaniel, 1978), and over 50% of the routine operational requirement of dairy farms (Albright, 1964), labour for milk harvest may be reduced by adopting a system of milking that allows high milk yield at a faster flow rate. For economics of milk production therefore, twice a day (TAD) milking appears to provide optimum milking frequency for Red Sokoto goats in this study. This is because there was a 40% (200 g) increase in milk yield with a marginal reduction in flow rate of 14% (0.6 g/s) compared to once a day (OAD) milking. Although thrice a day (THAD) milking had a significant increase in milk yield of 50% (300 g), there was a wide reduction in milk flow rate of 52% (1.5g/s) when compared with OAD milking. All the same, THAD milking provided an increase of 10% (56 g) over TAD), but this was not significant ($P>0.05$) and cannot compensate for the reduction in the milk flow rate of 31% or 0.9 g/s. This suggests a better profit and economic margins for TAD since milking speed determines the dairy labour profit.

Accurate prediction of yield responses to increasing milking frequency is required for sound decisions by dairy producers to optimize economic returns (Erdman and Varner, 1995). It has been reported that more frequent removal of milk enables a longer maximal secretion rate (Barpele et al., 1995). In Red Sokoto goats, both total milk yield and efficiency of milk

Table 24: Least squares means of dairy characteristics by milking frequency of Red Sokoto goats

Characteristics	N	Once	Twice	Thrice	Overall
Total yield (kg)	10	39.6±3.01[b]	60.1±3.59[a]	66.8±2.58[a]	55.5±2.95
Mean daily yield(kg/day)	10	0.3±0.03[b]	0.6±0.02[a]	0.6±0.02[a]	0.5±0.03
Peak yield (kg/d)	10	0.6±0.03[b]	0.9±0.06[a]	0.9±0.06[a]	0.8±0.04
Peak day(days)	10	27.5±1.41	36.8±6.71	36.8±6.71	33.8±4.01
Flow rate (g/s)	10	4.4±0.48	2.9±0.21[b]	2.9±0.21[b]	3.7±0.25
Dairy merit (%)	10	10.3±0.47	10.9±0.34	10.9±0.34	10.6±0.21
Persistency (%)	10	96.6±6.30	92.0±2.25	99.5±15.21	96.1±7.92

a,b means on the same row with different superscripts differ significantly (P<0.05)

production were influenced positively by increasing milking frequency (Akpa et al., 2001b). However, the effect of milking frequency on milk composition of the goats has not been ascertained. Therefore, the effect of three milking frequencies (once, twice and thrice daily) on milk yield and composition of Red Sokoto goats was ascertained using a total of 24 lactating does on lactation period of 120 days (Akpa et al., 2005). The total and daily milk yield, % fat, %protein, %total solids, %Ash and %non-solid fat were 56.028kg, 0.467kg, 5.35%, 5.71%, 15.53%, 0.83% and 10.17%, respectively. Milk yield and composition were significantly (P<0.01) influenced by milking frequency. Increasing milking frequency also increased milk yield and composition. Milk yield and composition were significantly (P<0.01) influenced by milking frequency (Table 25). Increasing milk frequency also increased milk yield and composition. Milk yield was significantly (P<0.05) and positively correlated with milk composition (r = 0.89-0.98) and; the relationship was significantly enhanced by milking frequency. The percentage increases in milk yield from once daily to twice and thrice, and from twice to thrice were 52.66, 69.50 and 11.03%, respectively. Twice daily milking may have a better economic feasibility for Red Sokoto goats.

Table 25: Effect of milking frequency on total milk yield and composition

Milk composition	Frequency		
	Once	Twice	Thrice
Number of observations	8	8	8
Milk yield (kg)	39.480±0.137[c]	60.270±0.221[b]	66.920±0.198[a]
Fat yield (kg)	1.986±0.007[c]	2.917±0.011[b]	4.118±0.012[a]
Protein yield (kg)	2.184±0.008[c]	3.458±0.013[b]	3.988±0.013[a]
Total solid	5.996±0.021[c]	8.555±0.031[b]	11.317±0.033[a]
Ash (g)	340.480±1.19[c] 0	468.720±1.750[b]	558.88±0.021[a]
NSF(kg)	3.999±0.014[c]	5.797±0.021[b]	7.189±0.021[a]

a,b,c means on the same row with different superscripts differ significantly (P<0.05); NSF: not-solid-fat

Milk flow rate in goats is highly heritable (Recodeu et al., 1989). Selection for this trait has been suggested as a means of reducing the need for milking labour, since labour for milk harvest may account for as much as 80% of annual milking cost and over 50% of routine operational requirement of dairy farms (Akpa et al., 2003d). For the dairy farmer, decision as to milking frequency can have large economic effects since increasing milk frequency results in higher variable cost, such as feeds, labour and utilities among others. Twenty-four Red Sokoto goats were hand milked for 120 days to determine milk flow rate (Akpa et al., 2003d). The does were grouped into three for once, twice and thrice a day milking to determine the effect of milking frequency on milk flow rate. The average daily milk yield and flow rate were 466.9g and 3.5g/sec, respectively (Table 26). Milking frequency significantly ($P<0.01$) influenced milk yield and milk flow rate (Table 26). The higher the milking frequency the higher the milk yield but with decreasing flow rate. Milk yield and flow rate were significantly ($P<0.01$) and positively correlated ($r=0.88$). Both milk yield and flow rate reached their peak at the 4th week lactation. The optimum milking frequency for Red Sokoto goats was twice daily milking, since there was 52.7% increase in milk yield from once a day with a marginal 7.9% reduction in milk flow rate.

Table 26: least squares means for average daily milk yield and milk flow rate over 120 days lactation period

Frequency	N	Milk yield (g)	Flow rate (g/s)
Once a day	8	331.8 ± 19.56^{c}	3.9 ± 0.19^{a}
Twice a day	8	506.5 ± 31.63^{b}	3.6 ± 0.23^{b}
Thrice a day	8	562.4 ± 28.33^{a}	2.9 ± 0.16^{c}
Overall	24	466.9±26.51(23.61)	3.5±0.19(22.90)

a,b,c means on the same row with different superscripts differ significantly ($P<0.05$)

A study was conducted in Jigawa and Katsina States to relate lactation characteristics of goats with haemoglobin and potassium polymorphisms (Sam et al., 2012b; Table27). Potassium type had no significant effect on the lactation characteristics while Hb type significantly ($P<0.05$) influenced only average daily milk yield and peak yield with the heterozygote Hb genotype AB being superior to genotypes AA and BB.

Efficiency of Milk Production

There is limited information on the measures of efficiency of milk production in goats. Therefore, the biological advantages of goats as milk animals have been grossly underestimated. The Red Sokoto goats are the most important breed of goats in Nigeria and contribute about 70% of the country goats' population (Osuhor et al., 2002). A knowledge of their milk production efficiency (dairy merit) and optimum milking frequency would be useful in achieving good management and selection programmes for an improved milk production (Akpa et al., 2001b).An attempt to investigate the influence of milking frequency on efficiency of milk production in Red Sokoto goats utilized 24 does, divided into three groups of 8 each and hand-milked once, twice and thrice a day for 120 days (Akpa et al.,2001b). The results showed that in 120 days lactation, the total milk yield and gross energetic efficiency of milk production (dairy merit) was 55.5kg and 8%, respectively (Table 28). The net energy efficiency value was 34.4%, indicating a recovery of 34.4% energy of the total digestible nutrient of feed in milk. Milking frequency significantly ($P<0.01$) influenced efficiency of milk production. The characteristics estimating efficiency of milk production in Red Sokoto goats were highly variable (CV= 21.4-42.7%). The 8% dairy merit of Red Sokoto goats was low but with the high estimates of coefficient of variability (42.74%), there may be chances for improvement through selection and better management. However, when compared with calculated 25.3% for Saanen goats (Gall, 1996), the Red Sokoto goat was 32% as efficient in milk production as Saanen goat.

Study to determine milk yield and efficiency of estimation of total milk yield using average records in non-suckling Red Sokoto goats was also carried out (Akpa and Duru.,1999). The result showed that 12 weeks milk yield characteristic of non-suckling Red Sokoto does was similar to already existing reports on the breed. Milking Red Sokoto does once a day could supply a family of 8 members a daily requirement of 65g of milk. Therefore, a household of 8 members can effectively use four breeding does cycled over the year to meet their dairy requirement. One day or average of two days weekly records was adequate in estimating total yield with minimum error, and therefore, could be used to monitor milk yield characteristics of these goats on the field.

Table 27: Lactation characteristics of goats in Jigawa and Katsina States Based on Haemoglobin and potassium Types (mean ±se)

Factor	ADY(g)	TY(kg)	IY(g)	PD(days)	PY (g)	LL(days)	LDY(g)
Hb-type							
HbAA	253.70±2.92[a]	30.19±0.59	241.00±4.93	34.60±0.69	359.72±5.66[a]	119.00±1.57	107.13±0.61
HbAB	257.00±2.78[a]	30.32±0.58	244.42±0.58	32.68±0.67	385±36.15[a]	118.73±1.54	106.17±0.60
HbBB	240.55±5.55[b]	27.32±1.13	247.43±9.20	32.79±1.27	350.170[b]	113.60±2.99	105.96±1.16
K-type							
HK	248.41±2.01	29.65±0.59	244.36±3.39	33.09±0.47	360.41±4.05	118.32±1.12	106.94±0.43
LK	247.19±4.69	29.25±0.99	239.33±7.90	32.80±1.11	349.64±9.43	117.87±2.62	106.64±1.01

ADY = Average Daily Yield, TY = Total Yield, IY = Initial Yield, PD = Peak Day, PY =Peak Yield, LL = Lactation Length, LDY = Last Day Yield, Hb-type = hemoglobin type, K-type = potassium types

Lactation Pattern and Characteristics

Dairy development in Africa is still at its primary stage. What the farmers and researchers require now are simple parametric models that would describe the lactation pattern of the animals, which is necessary for their nutritional and reproductive management estimation of total lactation yield, expected time of peak production, peak yield and management decisions on the level of culling(Akpa et al.,2003c). Model to be used must be able to determine some differences such as low and high milk production. The suitability of exponential, parabolic exponential, inverse polynomial and gamma-type models in describing the lactation pattern of agro- pastoral Red Sokoto goats was assessed using 1122milk yield records (Akpa et al., 2003c). A total of 66 does from 6 herds were milked over a two year period (Table 30). Milk yield characteristics vary from 25 to 70% with the maximum variability observed for the week at peak production. The most efficient model was the gamma-type in terms of best fit (R2 = 98.1%; RSD= 0.0213; Random distribution of residuals, ($P<0.05$) and in describing the yield characteristics (Table 29).

Table 28: Least squares means for character estimating efficiency of milk production

Characters	N	Mean	Minimum	Maximum	CV(%)
Body weight (kg)	24	25.0±0.54	20.3	32.0	10.47
Total milk yield(kg)	24	55.5±3.95	29.8	78.0	26.09
Total fat yield (kg)	24	3.0±0.20	1.5	4.8	33.11
FCM(kg)	24	67.6±4.19	34.4	103.3	30.36
FCM(kg/w)	24	2.72±0.18	1.58	3.83	31.63
FCM (kg MW)	24	6.05±0.38	3.50	8.73	31.79
FCM (day/kgW)	24	0.02±0.001	0.01	0.07	30.25
FCM (day/kgMW)	24	0.05±0.03	0.03	0.07	31.10
NEE(%)	24	34.4±1.50	23.87	43.78	21.41
DM(%)	24	8.0±0.70	3.44	12.95	42.74

In goats, determination of lactation peak and other characteristics of the curve (rapidity in achieving the peak and persistence) are very important for genetic and feeding purposes. The level of peak yield and persistency determine to a large extent, the shape of the lactation curve(Akpa et al.,2002a).Milk yield of 66 nursing does recorded in Zaria, Nigeria were used to characterized the lactation curve and study the influencing factors in Red Sokoto goat (Akpa et al.,2002a). Lactation curve parameters obtained by fitting the model, Yt = atbe-ct were subjected to statistical analysis, using herd, season, parity, litter size and litter composition of dams. The result indicated that the lactation curve of these goats was characterized by milk production increasing in early lactation, attaining a peak at approximately 2 to 5 weeks post-partum and thereafter declining slowly to the end of lactation (Fig. 8, 9 and 10). The observed total yield, peak yield, peak day and the estimated persistency defined as C-(b+1) were 79.3kg, 1.2kg, 20.5 and 143.3, respectively (Table 30). Parameters 'a' and 'c' were strongly but negatively correlated (r= -0.53; P<0.05) and parity only affected (P<0.01) parameter 'a'. None of the factors significantly influenced parameter 'b'. The significant herd and season effects may have practical implications in determining optimal feeding management and season of breeding to maximize total lactation yield. Shapes of the lactation curve provided by the gamma-type model strongly suggest that animals with higher initial level of production are likely to attain the peak faster and thereafter decline at a slower rate than those with lower initial level of production. Non- genetic factors influencing the shape of lactation curve in Red Sokoto goats were herd, season and parity.

Table 29:Estimates for curve parameters and yield characteristics by models (Mean±SE)

Parameter/character	N	Gamma	Parabolic	Inverse	Exponential
b_0	66	0.452±0.03	0.968±0.036	0.006±0.0016	1.358±0.036
b_1	66	0.444±0.053	0.0045±0.002	0.0001±0.000	-
b_2	66	0.020±0.001	-0.00011±0.000	0.000018±0.00	0.011±0.005
R^2	66	98.1±0.07	94.2±0.22	85.5±0.05	69.3±0.53
Residual SD	6	0.0213	0.0213	0.0423	0.0709
Peak yield (kg/d)	66	1.148±0.090	-	1.290±0.024	-
Peak week	6	3.2±0.54	-	2.8±1.96	-
Total yield (kg)	6	93.0±0.31	91.5±0.22	97.4±0.29	86.7±0.16

Table 30:Actual and gamma-type means and standard errors for lactation characteristics

Characteristics	Actual			Gamma	
	N	Mean	SE	Mean	SE
Total yield (kg)	66	79.3	2.36	83.9	0.031
Peak day	66	20.5	2.52	13.7	3.78
Peak yield(kg)	66	1.2	0.05	0.978	0.121
Persistency	66	-	-	143.2	0.02

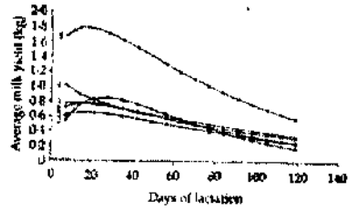


Figure 1 Effect of herd on goat lactation curves (herd number given on graph).

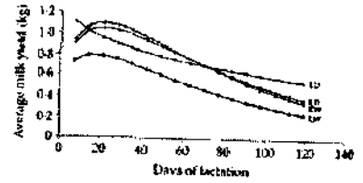


Figure 2 Effect of season of kidding on goat lactation curves: ED early dry; LD late dry; EW early wet; LW late wet.

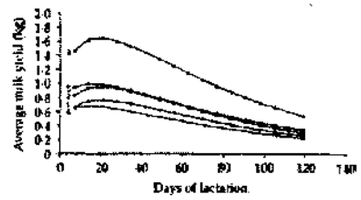


Figure 3 Effect of parity of doe on goat lactation curves (parity number given on graph).

If the ever widening shortfalls in dairy production supplies are to be met through indigenous production, there is an urgent need to exploit the potentials of goats as dairy animals to supplement milk from cows. Understanding the ascending phase lactation events would assist in breeding and management of Red Sokoto goats as dairy goats. Therefore, the ascending phase milk yield characteristics of Red Sokoto goats were evaluated using 120 days milk yield records obtained from 92 lactating does in 6 herds, collected over a two year period (Akpa et al., 2000a). The ascending phase milk yield characteristics (number of days, daily yield and total yield) were highly variable (47.6-74.5%) and were significantly ($P<0.01$) influenced by herd, season and parity, but not by litter size and litter composition (Table 31). Highly positive and significant ($P<0.01$) correlation ($r = 0.62$) exist between total yield and ascending phase total and average daily yield, respectively. Negative and significant ($P<0.05$) correlation($r = -0.30$) was observed for peak week and days in the ascending phase. The significant herd and season effects may have practical implications in determining practical feeding management and season of breeding to maximize total lactation yield. The effect of parity points to the fact that, it is not necessary to cull lactating does before parity 5. The lactation

persistency of agro-pastoral Red Sokoto goats was evaluated using records obtained from 92 does in 6 herds collected over a two years period (Akpa et al., 2003a). The result indicated a lactation persistency of 84% with variability of 14.5%. Season of kidding significantly (P<0.05) influenced lactation persistency in Red Sokoto goats.

Table 31: Least squares means for ascending phase milk yield characteristics by herd, season, parity, litter size and litter composition

Factors	N	No of days	Daily yield (kg)	Total yield (kg)
Herd				
1	12	33.8±5.59	0.897±0.084	20.6±1.66 [b]
2	20	30.0±2.65	1.009±0.077	36.5±2.67 [b]
3	10	21.6±4.47	0.869±0.038	28.4±2.29 [b]
4	10	14.9±5.25	1.096±0.068	17.9±2.81 [b]
5	18	20.7±4.17	1.198±0.117	23.7±1.62 [b]
6	22	24.9±44.12	1.129±0.067	25.8±2.16 [b]
Season				
Early dry	14	24.7±7.34 [a b]	0.951±0.082	24.5±3.61
Late dry	22	37.6±16.33 [a]	1.121±0.056	30.1±2.66
Early wet	35	16.4±2.22 [b]	0.995±0.041	22.6±1.01
Late wet	21	17.0±2.64 [b]	1.081±0.071	22.0±2.42
Parity				
1	30	28.7±4.48	0.788±0.043 [b]	22.3±1.31
2	24	17.0±3.31	1.243±0.08 [a]	23.1±2.53
3	16	24.2±5.06	1.241±0.072 [a]	27.9±2.33
4	13	22.2±5.83	0.924±0.049 [a b]	25.4±4.01
5	9	26.0±5.86	0.965±0.061 [a b]	24.8±3.89
Litter size				
1	41	22.8±3.06	1.047±0.050	19.8±1.20
2	34	23.6±4.31	0.971±0.039	22.8±3.33
3	17	27.8±3.35	1.09±0.530	30.6±2.31
Litter composition				
Male (single)	23	28.4±5.59	1.076±0.063	23.9±1.25
Female (single)	18	16.5±3.17	1.020±0.042	21.7±2.07
All males	13	16.3±4.30	0.959±0.061	18.2±1.18
All females	17	22.8±11.21	1.024±0.034	24.6±2.78
Male and female	21	37.7 ±13.30	1.081±0.010	34.6±6.62

a,b,c means on the same row with different superscripts differ significantly (P<0.05)

Mammary Morphology And Relationship With Milk Yield

The udder is the main body part of a dairy animal commonly understood to be related to its milk production capacity. In goats, udder characteristics, milk production, and milking time and rate are traits with adequate genetic variation to allow selection response

(Mavrogenis et al., 1989). The knowledge of the relationships between these traits can be utilized in the design of breeding programmes to improve milk quantity and quality, and to identify certain morphological and physiological factors related to changes in these traits. Sources of variation in morphological udder traits of Red Sokoto goats were investigated (Akpa et al., 1998b). Results of the investigation indicated that udder and teats size characteristics in Red Sokoto goats were similar to those found in dairy goats. These traits increased with increase in age and parity of doe; thus indicating the possibility of the morphological aptitude of the goat udder to mechanical milking improving as parity and age of doe increased. Effect of coat type on these traits showed that does with smooth and shiny coat had higher udder circumference and udder length than those with rough and doll coat; implying that coat type can be used for udder characterization in Red Sokoto goats. The udder size characteristics were positively correlated; implying that improvement in one would lead to improvement on the others. Wattle had no significant effect on the morphological udder characteristics in Red Sokoto goats.

There is rising interest on small ruminants morphological udder traits (Mather and Vrayla-Anesti.,1994) with emphasis on the relationship of the traits with milk yield, teat cup slips and milking management (Labussiere,1988) and factors that affect them (Fernandez et al.,1995). In the Red Sokoto goats, studies were conducted to elucidate the udder morphological traits, factors affecting them and relationship with milk yield (Akpa et al., 2003b; Sam et al., 2012a). The results showed that in lactating Red Sokoto goats, the average udder and teat size characteristics were udder circumference 38.8cm; udder height 17.1cm; distance between teats 11.5cm; teat circumference 7.2cm; and teat length 5.2cm (Table 32). Udder circumference and udder height were low in variability (13.7-16.1%) while the teat size traits were moderately to highly variable (28.6-42.9%). Thus, there is adequate variation in these traits to allow for selection response.

Table 32: least squares means for milk yield and udder size characteristics in Red Sokoto goats

Characteristics	Mean±se	CV%
Initial yield (kg)	0.946±0.034	45.7
Daily yield (kg/d)	0.664±0.021	38.9
Peak yield (kg)	1.205±0.051	52.2
Total yield (kg)	79.827±2.390	38.6
Udder circumference (cm)	38.800±0.910	13.7
Udder height (cm)	17.100±0.450	16.1
Distance between teats (cm)	11.500±0.550	28.6
Teat circumference (cm)	7.200±0.570	42.9
Teat length (cm)	5.100±0.300	34.7

Increasing parity increased udder and teat size up to 3rd parity when it leveled at the 4th and 5th parities. Udder circumference, udder height, distance between teats and milk yield increased with increase in litter size. Udder size characteristics were positively correlated with milk yield. Low correlation of teat size with milk yield suggest that they can be selected for, without modifying milk yield because their genetic correlations with milk yield are nil or at best low(Mavrogenis et al.,1989)

Prediction of milk yield from external measurements of udder in Red Sokoto goats can be based on udder height, udder circumference, distance between teats and teat length. The positive correlation between udder and teat size traits would suggest that as udder height increased, UC, TL and TC would increase correspondingly; thus, making wider udder desirable since cistern height and teat position and angle may increase (Fernandez et al.,1995). The season of kidding affected udder traits, and therefore would be considered in designing breeding programmes to improve milk production in Red Sokoto goat. Does kidding in the wet season had larger UC and longer UH than does kidding in the dry season. Multiparous does producing all male kids had the largest UC; while UH was longest for multiple bearing does irrespective of sex composition.

Incidence of Supernumerary Teats in Smallholder Goats

One of the major udder abnormalities that affect milking efficiency of dairy animals is the presence of supernumerary teat. The trait is hereditary and not uncommon in goats to have a kid born with extra teat or teats (supernumerary) with multiple ends. These

small teats are commonly imperforated and are not harmful but occasionally they leak during milking and they can also become infected from time-to-time. Therefore, female kids should be examined for this abnormality. The variations that occur in the expression of supernumerary teats in matured females are the normal two teat condition, occurrence of one extra teat and occurrence of two extra teats (Plate 8). In a survey of 58 smallholder Red Sokoto goats herds (comprised of 332 females and 119 males) in Kano state, it was observed (Akpa et al., 2010b) that the incidence of supernumerary teats was not common (11%) in the population of the goats in the studied area and was observed to decrease with increase in herd size (Table 33). Also, in another study conducted in Katsina state, it was observed that, out of the 811 female goats studied, only 24% of them expressed supernumerary teat of varying degrees; (1, 2 or 3). This suggests that the incidence of supernumerary teats in Red Sokoto goats is minimal and when present it is mostly bilateral.

Table 33 : Incidence of supernumerary teats in does of smallholder goats in Kano state

Attributes	≤ 10 goats	11-20 goats	21-30 goats	Overall
Number of herds observed	46	9	3	58
Number of goats observed	242	125	84	451
Number of females observed	191(58)	89(26)	52(16)	332(74)
Females with normal teats	167(57)	81(28)	46(16)	294(89)
Females with supernumerary teats	24 (63)	8(21)	6(16)	38(11)
Female with unilateral supernumerary teats	13(50)	8(31)	5(19)	26(68)
Female with bilateral supernumerary teats	11(92)	0(0)	1(8)	12(32)

Figures in parenthesis are percentages

A study conducted in 2011 on the incidence of supernumerary teats in Nigerian goats using 948 goats from 104 herds in the northern and central plateau revealed an incidence of (37.67%). Positioning of supernumerary teat was unilaterally on the left teat (46.67%) or the right teat (24.85%) or bilaterally (28.48%). Dams with supernumerary teats had (43.45%) chances of expressing it in their offspring's.



Plate 8: Supernumerary teats in Red Sokoto goat

Genetic Parameters and Relationship Estimations

Genetic improvement programme in low input system could be greatly enhanced if they were designated to primarily target farmers (Ahuya et al., 2005). Where flock sizes are small, farmers know their animals very well and in many cases can recall the pedigree of their animals. It is preferable to start with a few of the most important traits in a breeding objective rather than a combination of all the important traits (Philipson et al.,2006). If measurements such as animal weights are linked to prices in organized marketing system, farmers quickly realized how useful records are and adopt them (Kosgey and Okeyo, 2007). Adaptability of genotypes to the existing and future environments, as well as the need and aspirations of the farmers, is paramount for genetic improvement of small ruminants at small holder level. Estimation of genetic parameters is very important for any genetic improvement programme. The genetic make-up of the individual includes additive genetic combinations. These combinations interact with the environmental conditions such as climate, nutrition and management and intrinsic factors such as sex, age, physiological status as well as other extrinsic factors (maternal effect and random environmental factors) to determine the ultimate expression of animal performance

(Wattiaux, 2002). The goal of livestock production is to produce quantity and quality product with maximum efficiency. Unbiased heritability and repeatability estimates as well as accurate correlations (genetic and phenotypic) among performance traits in the breeding objective and the selection criteria are required to design selection programme for livestock.

A study was carried out (Iyiola-Tunji et al., 2008a; Akpa et al.,2009) to estimate the heritability and repeatability of body weight and body measurements at different stages of growth of kids and the relationships that exist between the body weight and body measurements of Red Sokoto kids up to 9 months of age at the smallholder production system. The estimates of heritability ranged from 0.59 to 0.93, while the corresponding repeatability estimates ranged from 0.70 to 0.97 which were considerably high at all ages for the measures of growth of Red Sokoto kids (Table 34). In another study (Iyiola-Tunji et al., 2008a), heritability, repeatability and phenotypic correlations of growth traits of Red Sokoto goats were estimated; heritability estimates were 0.99, 0.97, 0.76 and 0.70 for adjusted weaning weight, weaning weight, yearling weight and post weaning daily gain. The repeatability of birth weight, adjusted weaning weight (ADWT) and yearling weight (WT12) was 0.39, 0.28, and 0.17, respectively. Findings from these studies suggest that better appraisal of Red Sokoto goats for body weight will be possible by considering the relationship between post weaning daily gain and WT12. This relationship between post weaning daily gain and WT12 may help breeders in early selection of replacement stock through performance testing.

Table 34: Estimates of heritability (h^2) and repeatability(r) for body weight and body measurements in Red Sokoto kids at different growth stages.

Trait	h(+se)	r(+se)
Birth weight	0.59± 0.02	-
One month weight	0.93± 0.02	0.97 ± 0.001
One month height-at-withers	0.78± 0.02	0.81 ±0.001
One month body length	0.70± 0.02	0.79 ±0.001
One month chest girth	0.74± 0.02	0.79 ±0.001
Three month weight	0.78 ±0.03	0.95 ±0.001
Three month height-at-withers	0.80 ±0.02	0.81 ±0.001
Three month body length	0.70 ±0.03	0.85 ±0.001
Three month chest girth	0.83 ±0.02	0.91 ± 0.002
Six month weight	0.70 ±0.03	0.96 ± 0.001
Six month height-at-withers	0.75 ±0.03	0.83 ±0.001
Six month body length	0.72 ±0.03	0.74 ±0.002
Six month chest girth	0.68 ±0.03	0.70 ± 0.002
Nine month weight	0.63 ±0.03	0.91 ±0.003

Nine month height-at-withers	0.71 ±0.02	0.83 ± 0.002
Nine month body length	0.70 ±0.02	0.81 ± 0.001
Nine month chest girth	0.80± 0.03	0.89 ± 0.004

The high heritability and repeatability estimates for the growth traits and their positive relationships are indications that selection for improved body weight and size early in life of these goats is possible. Estimation of genetic parameters for some reproductive traits in Red Sokoto goats have been conducted (Akpa et al., 2004a), From this study heritability of gestation length, litter size, litter genotype and sex ratio were 0.37, 0.589, 0.285 and 0.205, respectively. The genetic correlation of gestation length with litter size, litter genotype and sex ratio were -1.031, - 1.518 and 0.411, respectively. The genetic correlation of litter size with litter genotype and sex ratio were 0.867 and 0.269, respectively. The observed moderate to high heritability of these traits in the study might indicate the possibility of improving them through selection. Other relationship study of reproductive traits in Red Sokoto goats (Akpa, 1999a) revealed that the dams' body weight at kidding was negatively correlated with post-partum interval to conception ($r = -0.62$, $P<0.01$). Thus, indicating that the heavier the body weight, the shorter the interval. The repeatability estimate for postpartum interval to conception was low (0.03).

Heritability and relationship estimates for morphological udder traits have been conducted in Red Sokoto goats (Akpa et al., 1998b). The heritability of udder morphological traits was high for udder circumference (0.64), udder length (0.42) and teat circumference (0.49) but low for teat length (0.16). The correlated relationship between the udder morphological traits was significant and positive ($P<0.05$; $r = 0.24$-0.57). The positive relationships between the morphological udder traits and the high heritability estimates of UC, UL, and TC may implicate them as possible selection markers to improve the Red Sokoto goats milking ability.

The measured growth characteristics which are birth weight, 1, 3, 6 and 9 months of age BW, HW, BL and CG, respectively, were positively correlated amongst themselves. However, the correlated relationships of BL and CG at 6 months of age with other measures of growth were not significant ($P>0.05$) and ranged between 0.017 and 0.098; except the relationship between BL and

HW at 6 months of age (P<0.05; r = 0.439). At the other age categories, the relationships were strong and significant (P<0.01-0.05). Birth weight had the strongest relationship with BW at 1 month (0.983), followed by its relationship with BW at 9 months of age (0.749). The relationship between HW and BW was strongest for HW, and WT6; while that of BL was for BL3 and WT6 (0.585).

Animal live weight is an important feature but can seldom be measured in rural areas due to lack of reasonably accurate scale. Hence, relationship between body weight and linear body measurement such as HG, BL, and HW that can easily be measured could be used in BW estimation. Therefore, a study was conducted (Akpa et al., 2009) to estimate body weight using combination of linear body measurements in Red Sokoto goats (Table 35). The results revealed that linear body measurements significantly (P<0.01) estimated BW of Red Sokoto kids at various age categories with good efficiency (R2 = 49.2 82.4%). At one month of age, BW was best estimated by a combination of HW, and BL (R2 = 82.35%).

Estimation of BW at 6 months of age showed that it would best be estimated by combing HW, BL and CG(R2 = 62.80%). At 9 month of age, combination of HW and CG would give the best estimate (R2 = 68.05%). This implies that combination of linear body measurements can be used with high degree of reliability to estimate body weight in Red Sokoto goats.

Table 35: Prediction of weight traits using combination of linear body measurements at 1, 3, 6 and 9 months of age in Red Sokoto kids

Traits	Prediction equations	LOS	R^2 (%)
One month weight	$Y_1 = -6795 + 0.03292X_1 + 0.02755X_3$	**	82.35
Three month weight	$Y_2 = 1.86789 + 0.002081X_1 + 0.04518X_2$	**	49.20
Six month weight	$Y_3 = 6.02011 + 0.02044X_1 + 0.0095814X_2$	**	62.80
Nine month weight	$Y_4 = 3.33120 + 0.12452X_1 + 1.68024X_3$	**	68.05

** P< 0.01, * P< 0.05, LOS : level of significant, R2: coefficient of determination; X1:height at withers; X2: body length; X3: chest girth

In a similar study (Akpa et al., 2010a) the prediction equations relating body weight characteristics with the combination of linear body measurement adequately estimated mating weight,

kidding weight and 60day post kidding weight in Red Sokoto goats (R2 = 54.7 72.0%). However, the equation for the prediction of 60 day post- kidding weight using the combination of linear body measurements (HW, BL, CG) was the best, explaining about 72% (R2 = 72.0%) of the variation in the 60d PKwt of the does followed by kidding weight (R2 = 55.4%) and mating weight (R2 = 54.76%), respectively (Table.36). It is therefore possible to estimate 60 day post kidding weight (60dPKwt) of the Red Sokoto does using linear body measurements.

Table 36: Effect of sex on birth weight, body weight and Body measurements at different ages in Red Sokoto kids.

Traits	Prediction equations	LOS	R^2(%)
Mating weight (Y1)	Y1= - 20.639-0.047X1+0.190X2 + 0.0494X3	**	54.7
Pre-kidding weight gain (Y2)	Y2= 3.73 + 0.037 X1+0.107X2-0.019X3	NS	9.9
Pre-kidding rate of gain (Y3)	Y3= 0.017 – 0.005X1 + 0.010X2 – 0.003X3	NS	4.5
Kidding weight (Y4)	Y4= 15.070 +0003X1 + 0.277X2 + 0.355X3	**	55.4
60 days post kidding weight (Y5)	Y5= 26.741 + 0.118X1 +0.143X2 + 0.529X3	**	72.0
Post kidding weight change (Y6)	Y6= 11.337 – 0.115X1 + 0.120X2 – 0.156X3	**	11.3

X1=height-at-withers. X2=body length, X3= chest girt; ** P<0.01; NS=not significant; LOS: level of significant

Genomics Studies in Nigerian Goats

One of the primary goals in the management of animal population is to maintain their genetic diversity at a high level and their inbreeding at a low level. To estimate the future breeding potential of a livestock breed, it is necessary to characterize the genetic structure and estimate the level of genetic diversity within the breed. For this purpose, pedigree information and genetic materials are used. From genetic materials, microsatellite markers and mitochondrial DNA displacement loop (D-loop) are commonly used to describe the genetic polymorphism, genetic distance and geographical origin of domestic animals. A study was conducted in 2012 and 2013 (Ojo, 2013) using data from 200 goats to evaluate Nigerian breeds of goat in terms of body size; allelic frequencies of different gene loci; degree of polymorphism in markers; genetic relationships between the Nigerian goats; and genetic diversity within and between the Nigerian goats. The goats were sampled from Jigawa, Kaduna and Oyo states of Nigeria with 60 goats each sampled from Red Sokoto, Sahel and West African dwarf, and 20 from Kano brown.

The body size descriptors of the Nigerian breeds of goat are presented in Table 37. The Sahel breed had the highest body size which was highly variable, followed by Red Sokoto which was similar to Kano brown. The least means for body size descriptors were observed for WAD. The principal component analysis of body size determinants in the studied breeds revealed that for Sahel and WAD, height at withers (0.76 and 0.72 respectively) had the greatest contribution to body size; while for Red Sokoto and Kano brown, the largest contribution came from heart girth (0.82). The principal component analysis (PCA) of the allele frequency data of the Nigerian goat breeds using 25 microsatellite markers is presented in Figure 4. The variation accounted for by PC1 and PC2 were 31.04% and 19.06%, respectively; which adds up to 50.1%. This result shows that the Nigerian breeds of goat are admixed and that there are no distinct clusters on the basis of geographical regions where the breeds were sampled.

Table 37: Descriptive statistics of the phenotypic traits of the Nigerian Indigenous goat breeds.

Trait	Sahel			Red Sokoto			West African Dwarf			Kano Brown			LOS
	Mean ± SE	σ^2	CV(%)	Mean ± SE	σ^2	CV(%)	Mean ± SE	σ^2	CV(%)	Mean ± SE	σ^2	CV(%)	
Body length (cm)	65.4±0.90^{a}	48.72	10.67	61.6±0.60^{b}	21.64	7.55	53.8±0.84^{c}	42.71	12.339	59.9±0.56^{b}	6.26	4.16	**
Height at wither (cm)	63.2±0.70^{a}	29.16	8.55	61.3±0.61^{a}	22.43	7.73	55.9±0.86^{c}	41.87	11.579	59.2±0.75^{b}	11.12	5.63	**
Chest girth (cm)	65.4±0.75^{a}	33.91	8.90	63.3±0.98^{a}	57.62	12.00	55.9±0.94^{c}	52.49	12.97	62.7±0.66^{b}	8.66	4.70	**

CV=coefficient of variation; LOS= level of significance; **= P<0.01; σ^2 = variance

^{a,b,c} Means in the same row with different superscripts are significantly different at P<0.05

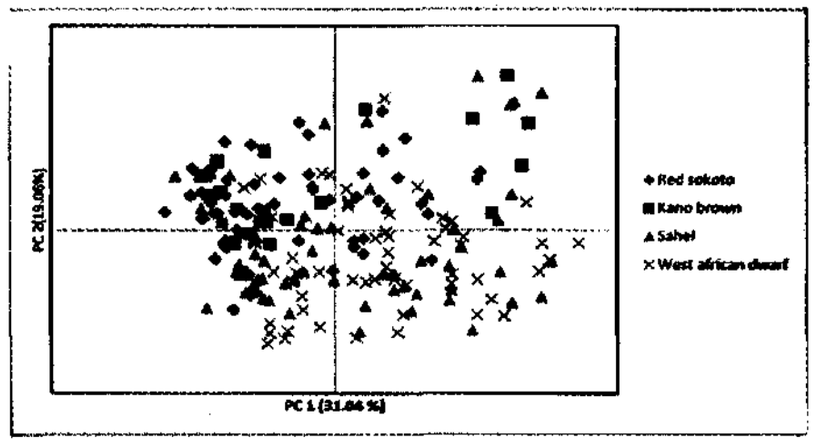


Figure 4: Two-dimensional graph representing the relationship between PC1 and PC2 using allele frequency data from 25 micro-satellite loci typed in 4 Nigerian goat populations.

The allelic frequencies of different gene loci in the Nigerian breeds of goat as observed in the different measures of genetic variations (i.e. Number of alleles, Number of effective alleles and Shannon index) showed that all the studied loci were highly polymorphic, having more than four alleles in all loci across the breeds; effective alleles for Sahel 1.12-7.90, Red Sokoto 1.34-9.29, Kano brown 1.13-8.99, and WAD 1.12-8.57; and Shannon index in most cases was above 1.0 across breeds. The application of F-statistics to determine the extent of inbreeding and outcross in the Nigerian breeds revealed inbreeding status (0.143) for Sahel. Although the inbreeding status was low, 20 out of the 25 loci studied had inbreeding status while only 5 showed outcross, indicating the presence of more heterozygotes at those loci. Red Sokoto showed inbreeding/ homozygous status for 18 loci while exhibiting outcross status for 7 loci. The outcross and inbreeding/ homozygous status was exhibited in 10 and 15 loci, respectively in Kano brown. In the WAD the population had a low inbred status (0.167) with 6 showing outcross while 19 loci exhibited inbreeding/ homozygous status.

The dendogram or un-weighted pair group method analysis (UPGMA) tree of the Nigerian goats mitochondria DNA (mtDNA) sequences is shown in Figure 5. The phylogenetic tree shows that all the breeds originated from a common source. However, WAD diverged first and is more genetically distinct. This was followed by Sahel and lastly, Red Sokoto and Kano brown, though separated are more genetically and closely related.

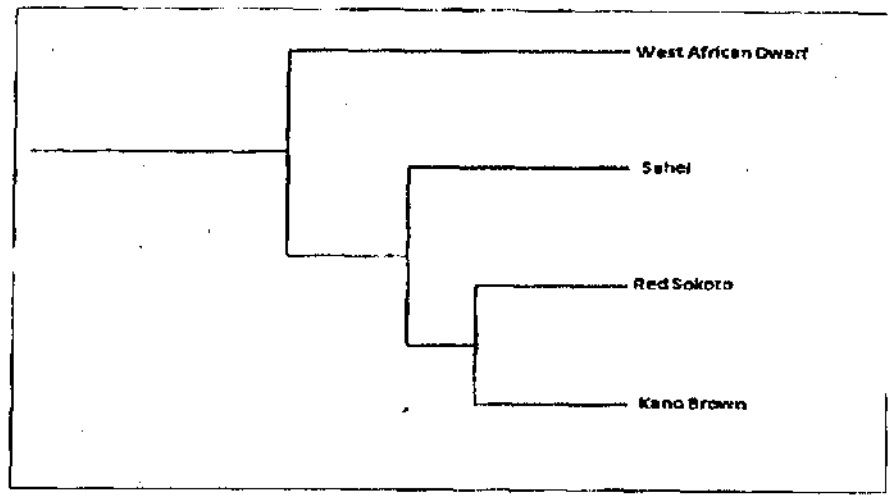


Figure 5: Dendogram representing the genetic relationship between the four Nigerian populations

An evano-graph in Figure 14 was plotted to detect the genetic structure of the Nigerian goat breeds, as well as to determine the true number of clusters (K) for them. The value with the highest mode (delta K) is usually an indication of the true number of clusters. From the Figure, the variability among the breeds was from K=2 to K=5. The highest likelihood was observed at K=2, indicating two major locations (North and South) for the Nigerian breeds of goat.

The estimated population structure among breeds is presented in Figure 15. To examine relatedness between the breeds, allelic frequencies were analyzed using structure 2.0. Each individual was represented by a vertical line, often partitioned into coloured segments with the length of each segment representing the proportion of the individual's genome from K=2 to K=6. The first level of clustering (K=2) reflects the primary locations of the Nigerian breeds of goat, namely northern and southern Nigeria. There was a distinct cluster at this level which is consistent with the known locations of the goat breeds in Nigeria. Subsequent levels (K=3 to K=6) clearly showed signatures of admixture of the the goats, indicating that the Nigerian goat breeds were not genetically differentiated but had admixtures that might have resulted from

indiscriminate mating between breeds as well as migration between breeds.

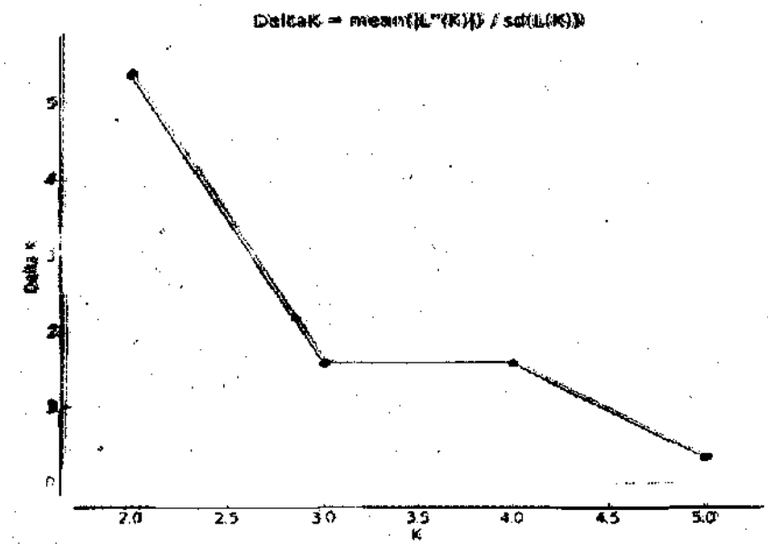


Figure 14: Evano graph of Nigerian goat population

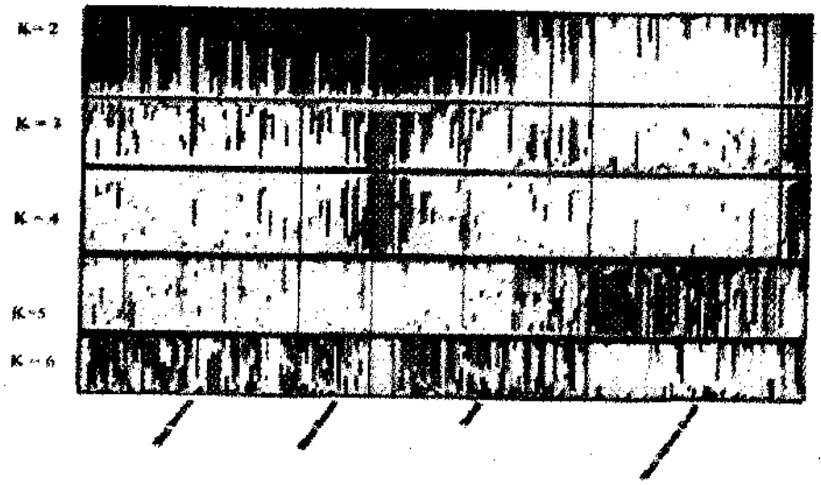


Figure 15: Estimated population structure of the Nigerian goat population

Summary and Conclusion

Summary

Studies, spanning over a period of 21 years (1992-2013) were used to evaluate the dairy potentials of red Sokoto goat (RSG). The studies encompassed production and management, heard structure and breeding practices, reproduction, body growth, morphological structures, genetic distance, blood biochemical polymorphism, adaptation, blood biochemistry, milk yield and composition, lactation pattern, mammary morphology, incidence of supernumerary teats, genetic parameters and relationship estimations, and genomics. The investigations revealed that the average herd size of goats in Zaria was 19.8 goats; which was influenced by source of foundation stock, labour and location. Goats grazed morning and evening and supplemented with feed and regular water supply performed better than others. Milk production behavior of RSG was better for agro-pastoral (23.5-69.7) than institutional system except for lactation peak week (8%) and persistency (22%). Goats herd structure and breeding practices showed that 48% of the does were in their 2nd and 3rd parity and aged between 12 and 25 months. Criteria used in meeting the selection goals were based on health, udder development, bone structure, hair texture and tail structure. Breeding of does at early dry season and rebreeding after kidding at early wet, offers an opportunity for twice yearly kidding in RSG. Brown and light brown goats were superior in body weight and height at withers; and HG and BL could be used to estimate BW of RSG across ages. On milk yield and composition, 120 days milk yield traits were TY 55.5kg, ADY 0.466kg, PY 0.791kg, PD33.8day, flow rate 3.7g/s, dairy merit 10.6% and persistency 96.1%. Milk composition was fat 5,35%, protein 5.7% TS 15.53%, Ash 0.83% and SNF 10.17%. The optimum milking frequency for RSG was twice daily milking. The lactation pattern was characterized by increasing milk production at the early lactation, attaining a peak at approximately 2-5 weeks and thereafter declining slowly to the end of lactation. However, in lactating RSG, the average udder and teat size traits was UC38.8cm, UH 17.1cm, DbT 11.5cm, TC 7.2cm and TL 5.2cm. Udder size traits were positively correlated with milk yield. The heritability of

udder morphological traits was high, UC 0.64, UH 0.42, and TC 0.49. The genomics studies in the Nigerian breeds of goats showed that 96% of the total genetic variation was due to genetic differences within breeds while 4% was due to differences between breeds. There was low genetic differentiation (Fst 0.030) between breeds and high level of admixture across the breeds. The inbreeding coefficient (Fis) in the breeds was low (0.105) with high gene flow (14.868). The Nigerian breeds of goat originated from a common source with the WAD diverging first; followed by the Sahel and last, the Red Sokoto and Kano brown which although separated are more genetically and closely related. Therefore, the RSG is numerous with good growth and reproductive potentials that would support its development as dairy goat. Its dairy traits in terms of milk yield and composition, flow rate, dairy merit, persistency and production pattern are comparable with those of typical dairy goats. However, in its dairy development path-way, the following factors should be considered: herd, age, parity, litter size, postpartum intervals to conception, nutrition, management, coat colour and texture, body and udder structures, milking frequency, adaptability and compatibility with other indigenous breeds. The morphological udder traits of RSG have high heritability that would support improvement of their milking ability with much progress.

Future Research Direction

To develop a Nigerian breed of goat with the following descriptors:

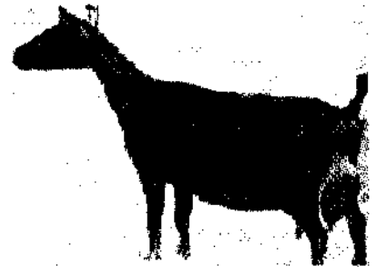
* Brown, short, smooth and shiny haired goat
* > 30kg body weight at maturity
* Twice yearly kidding
* >2 kids per kidding
* > 2.5 kg milk/day in 120 days lactation period
* Highly feed efficient
* Well adapted to the Tropical Savannah Environment

Conclusion

The Red Sokoto goat is highly prolific with favourable growth and reproductive characteristics. A successful breed improvement at the smallholder level should consider health, udder development, bone structure, coat colour and hair texture, age, parity and litter size of does.

Milk yield traits in RSG were non-homogenous and therefore, suggest the possibility of improving daily production by selecting high yielding does. The observed high lactation persistency suggests the ability of RSG to maintain milk production throughout lactation. From the existing lactation pattern, does with higher initial yield would attain the peak faster and thereafter decline at a slower rate than those with lower initial level of production.

Coat colour can be used for udder characteristics in RSG; and prediction of milk yield from external udder traits can be based on UH, UC, DBT and TL. However, the high heritability estimates of UC, UH and TC may implicate them as possible selection markers to improving RSG milking ability. However, in designing improvement programmes for the milking ability of RSG, the following factors are to be considered; herd, season, parity, litter size, coat texture and colour, management, milking frequency, and closeness and compatibility with kano brown goat.






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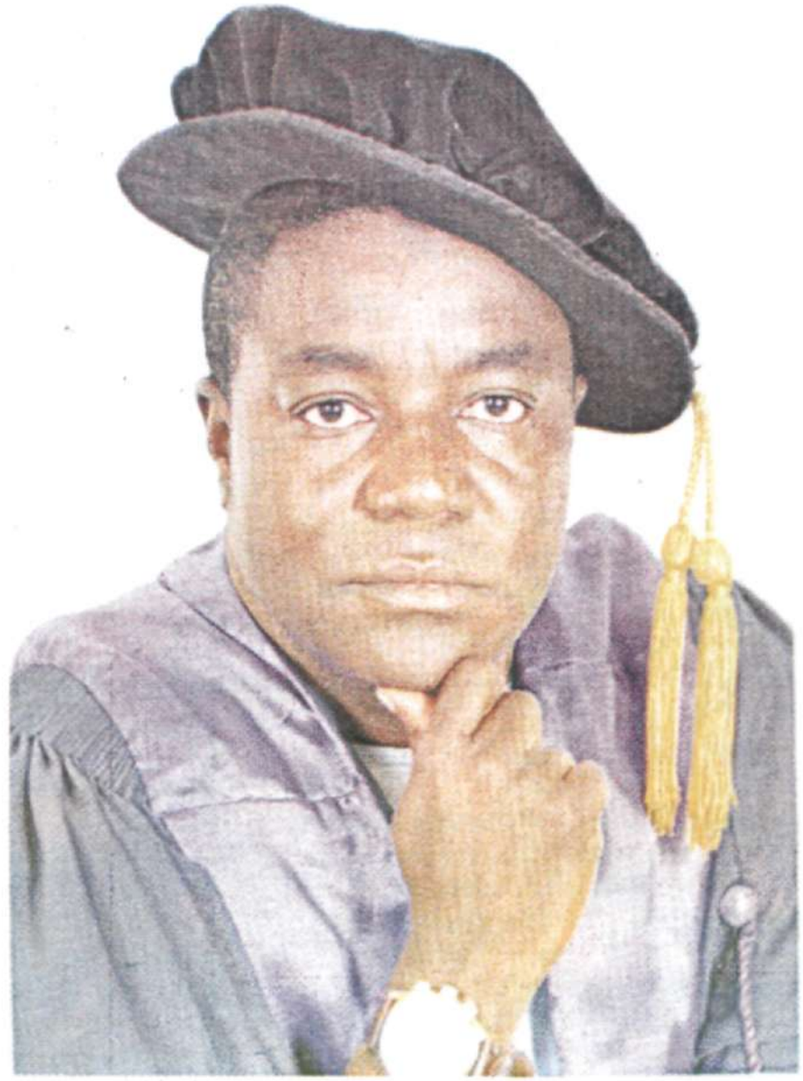
Chapter Four

Confronting Epidemics in Nigeria: Taking Status Quo off the Table

Confronting Epidemics in Nigeria: Taking Status Quo off the Table

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Preamble

I feel greatly honoured to be given this privilege to deliver this inaugural lecture on behalf of the Department of Community Medicine, the Faculty of Medicine Ahmadu Bello University Zaria. I am the first professor to deliver an inaugural lecture from this Department.

Sometime last year I was approached by the Dean of our Faculty on whether I would be able to present inaugural lecture on behalf of the Department. I could not respond in affirmative because it coincided with the time that I commenced my sabbatical leave in one of our collaborating partner the African Field Epidemiology Network (AFENET). However, 2 weeks ago when I was re-contacted by the dean I could not hesitate but to answer and swing into action. Therefore, this lecture I am presenting today is a product of 2-weeks effort, and I hope that it will meet the expectations of the organizers and the listeners. On a lighter note, perhaps this is in line with my lecture today, which is about dealing with emergencies. There is hardly any time to adequately prepare yet there is no room for mistakes.

Mr. Vice Chancellor Sir; kindly permit me to start today's lectures titled "Confronting Epidemics in Nigeria: Taking status quo off the table" by first and foremost presenting the outline of the presentation viz;

Outline of presentation

Background to Epidemics
Definitional Issues
The Pattern of Medical Epidemics in Nigeria
The effects and consequences of Epidemics
The Traditional approaches to control epidemic
The emerging trends in epidemics
The concept of one health
The Nigerian response to one health initiative
The role of Tertiary Institutions
The successes recorded
The challenges and prospects
Conclusion

1. BACKGROUND

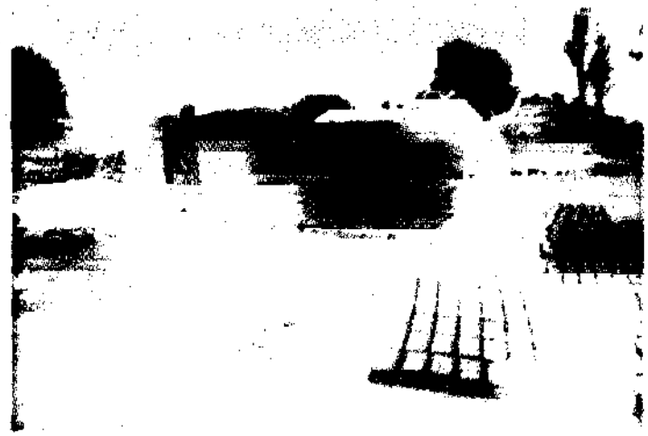
To vividly illuminate this presentation I will like to start with the following prologue:

"This was the only child we had with my wife, exclaimed Mal.Lawal (not his real name). We have been married for 15 years and 3 years ago we joyously welcomed our first son and only child, Master Musa Lawal (not his real name). Three days ago Musa was taken ill; his gums were swollen probably due to eruption of new teeth. His mother took him to a nearby health facility for treatment and was given a teething soothing mixture known as "Drug X". Yesterday he stopped passing urine and we were referred to the teaching hospital where we were informed that his kidneys had shut down and he died last night. While sobbing, Mal. Lawal explains that he can't understand what really happened , the rapidity of events in the last 72 hours is astonishing, from a bouncing playful boy to funeral arrangements for his precious baby boy. He explains, as he shows pictures of his boy, that something could have been done to prevent the death of his son."

Three months after the inception of the Nigeria Field Epidemiology and Laboratory Training Program of the ABU(NFELTP) (www.nigeria-feltp.net) in December 2008, the trainees of the program were requested to investigate an outbreak of mysterious deaths of children under 5 years of age in a number of states in Nigeria. The trainees with support from US Centers for Disease Control and Prevention (CDC, the US Food and Drug Administration (FDA, the National Agency for Food and Drug Administration and Control (NAFDAC), the Federal Ministry of Health (FMOH) discovered that over 100 children had suffered acute renal failure (rapid shutdown of kidneys) with nearly all of them subsequently dying. Systematic field investigations(the hallmark of NFELTP and other FELTPs)to gather information from care givers revealed that nearly all the children had taken a teething soothing mixture (known as Drug X). Further chemical analysis also revealed that the teething mixture had been contaminated with Diethylene Glycol (DEG, a cheap substitute for solvents used in most drugs manufacturing processing. DEG causes kidney damage and can rapidly cause death. Rapid investigation helped discover the contaminated batches of the implicated drug, and effectively recalling the drug and targeted public health messages to care givers to avoid the implicated drug. Hundreds of would be victims of drug poisoning were prevented from the permanent effects of the poisoning and death owing to the rapid investigations and timely response. As a follow up stricter drug

quality monitoring and capacity building for detection of drug contaminants were instituted by the Federal government of Nigeria.

My second story Mr Vice Chancellor Sir is Also a pathetic one which I intent to show with the Picture below



Chief of Dareta village, Nigeria. Site of 58 child deaths in last 3 months likely due to lead poisoning. Just after halting the process of making bricks for homes out of highly lead-contaminated gold mining waste (~ 200 times US EPA allowable limit for lead in soil).

NFELTP was created to build capacity in field epidemiology to support strengthening of public health systems particularly early detection of disease outbreak and rapid response. Over the years the program has supported training of disease detectives who have helped in early detection of outbreaks. These have ranged from infectious to non-infectious conditions, from rapid detection of lead poisoning in the north of the country to response to Lassa fever in the south of the country. Over 130 outbreaks have been investigated thoroughly and evidence provided for quality effective response preventing disease, disability and death".

Acknowledgement

I cannot conclude the celebration and celebration without paying due tribute to some people and institutions that have contributed to what we celebrate. So I would like to acknowledge Prof. Umaru Shehu the foundation Head of the Department of Community Medicine , late Prof. A. B. Bandipo, Prof. P. Singha, Dr. E. S. Essien, Dr C L Ejembi They developed the Department from scratch and laid the foundations for what we have today. I appreciate their invaluable contributions to my training and the guidance, nurturing and consolidation they have given me in my earlier career. They taught me the value of meticulous hard working and discipline in improving my skill as a public health physician.

I acknowledge Professor A. M. Yakubu my best teacher in the medical school. His systematic teaching of paediatrics might have kept my interest in that discipline, if I did not get a later vocation for Community Medicine and health for all.

I would like to acknowledge my other teachers in the Medical School like Professor Vahalia of Anatomy Department, Dr. Sheriff, Dr. Adeosun, Professor Ali, Professor Ogala, Professor Mr. and Professor Mrs. Mabogunje for instilling in me the determination for hard work, diligence, integrity as well as making a difference in whatever I do in my line through working with others to champion the processes for the attainment of positive change. I hope that I have justified your examples in the way I have done to myself ever since.

To my numerous friends, colleagues in the faculty such as the former Dean and current Dean Student Affairs Prof. M. S. Shehu, the present Dean faculty of Medicine Prof. Bakare, the Head of Community medicine Dr. M. N. Sambo, the past Heads of departments Dr. S. H. Idris, Dr. Shehu, and host of others too numerous to mention, I say thank you for your kind support and assistance.

I would like to acknowledge the following colleagues of mine with whom we have worked diligently from 2008 to date in the NFELTP program to get us to where we are now. Dr Patrick Nguku the Resident Advisor to the program, Dr Peter Nsubuga formerly from United State Center for Disease Control, Dr Okey

Nwanyawu the country CDC director, Dr Dalhatu Mohammed of CDC Nigeria, Dr Nasiru Sani Gwarzo who was in CDC during the take off of the program and its scale up but now in the FMOH. Prof Nasidi the director of the Nigerian Center for Disease Control (NCDC). My colleagues and friends the members of the faculty from University of Ibadan who are too numerous to mention here.

I also acknowledge the support and encouragements from the following institutions: Center for Disease Control Atlanta, AFENET, FMOH, FMOARD ABU Zaria and UI

I would like to acknowledge the Dan Amar of Zazzau Alhaji Garba, Alhaji, Dr Bashir Kurfi, Mal. Sani Hassan, Mrs. Ajayi a host of others who have stood by me through my most difficult and trying period in my life.

My father late Alhaji Mohammed Sabitu is not physically here but my mother Hajiya Ramatu Sabitu is here with me. I want to thank them for what they have done for me. I thank late Alhaji Adamu Ambi the Maji dadin Bauchi my senior brother for ensuring that I finished secondary school and entered University with minimal stress. I thank the rest of our family one and all.

I thank my children all the five of them Ramatu, Farida, Salim, Rukaya and Maryam who have always been supportive and helpful. I thank Hajiya Amina (Iyami) my beloved wife, sister and helpmate. She has always been there for me.

I remain grateful to the Ahmadu Bello University and Ahmadu Bello University Teaching Hospital for providing the conducive setting and giving me opportunity to be trained and later to train, teach and work in the institutions.

I thank you all for Listening. May the Almighty GOD Bless you abundantly

2. DEFINITIONAL ISSUES

Epidemic

The word Epidemic is from Greek *epi* (upon) , *demos* (people). It usually refers to the occurrence in a community or region of cases of an illness, specific health – related behavior, or other health – related events clearly in excess of normal expectancy.

It has also been defined as the occurrence of more cases of disease in a defined geographical area and or among a specific group of people over a particular period of time in excess of normal expectancy for that area and at that particular point in time. The amount of disease occurring in the past, in the absence of epidemic, defines the "expected" frequency. The term outbreak is sometimes used synonymously with epidemic.

There are several changes that may occur in an infectious agent that may trigger an epidemic these include:

- Increased virulence, i.e. the agent causing more severe disease than usual
- Introduction into a novel setting .i.e. agent getting into new population
- Changes in host susceptibility to the infectious agent i.e weaken immunity

Generally speaking, three major types of epidemics may be distinguished:

a. Common-source epidemics: which is further classified into two as follows
   - Single exposure or point source epidemics
   - Continuous or multiple exposure epidemics
b. Propagated epidemics: has three forms
   - Person-to-person
   - Athropod vector
   - Animal reservoir
c. Slow modern epidemics

Endemic

This refers to the constant presence of a disease or infectious agent within a given geographic area or population group. May also refer to the usual prevalence of a given disease within such an area or group.

Pandemic

This refers to an epidemic occurring worldwide or over a very wide area, crossing international boundaries and usually affecting a large number of people.

3. THE PATTERN OF MEDICAL EPIDEMICS IN NIGERIA

Major Epidemics	Year	No of cases	No of death	CFR
Cholera	2013	6400	352	5.5%
	2010	46,782	1841	3.9%
	1995	59134	4508	7.9%
CSM	2009	38586	2172	5.6%
Lassa Fever				
	2011	1246		
	2012	1723	70	4.1%
	2013	1700	112	6.6%
Measles				
	2005	150,000		
	2013	36,000	198	0.6%
Yellow Fever	1984 – 1992	20000	5000	25%

Fig 1: Occurrence of Cerebrospinal Meningitis over ten year period: 2002-2011

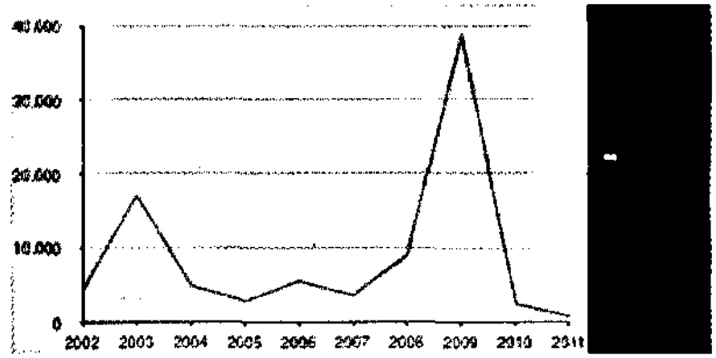


Fig 2: Trend in Measles occurrence over 10 years

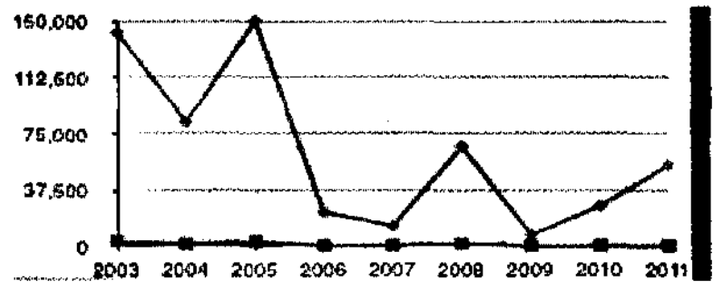


Fig 3: Trends in Lassa fever epidemic over ten year period: 2002-2011

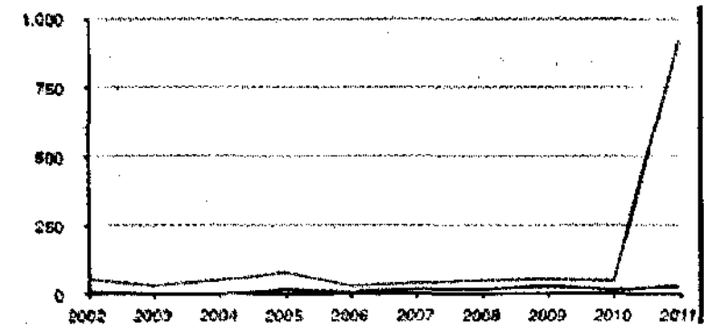


Fig 4: National HIV Median Prevalence in Nigeria: 1991-2010

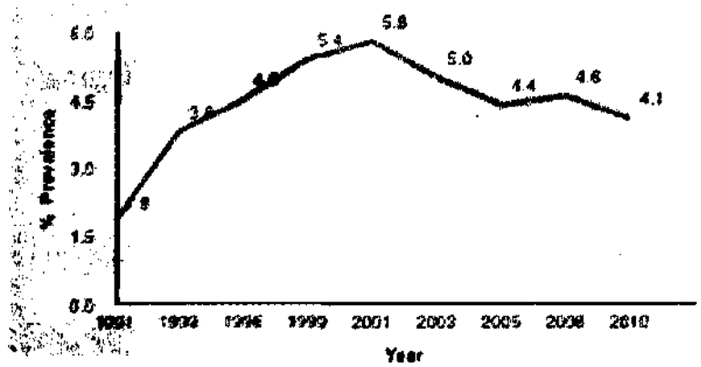
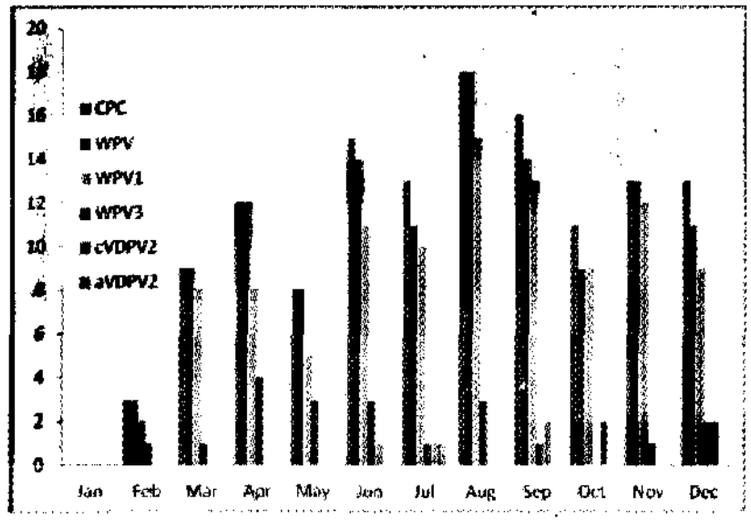


Fig 5: Monthly distribution of Wild Polio Virus (WPV) IN 2012



Epidemiology and Control of Some Epidemic Prone Diseases in Nigeria

CEREBROSPINAL MENINGITIS

Meningococcal meningitis, commonly designated as cerebrospinal meningitis, is the only form of bacterial meningitis which causes epidemics. Epidemics can occur in any part of the world.

Aetiology: It is caused by the meningococcus (Neisseria meningitidis) Gram-negative diplococcus with capsular polysaccharide antigens and different serogroups (A, B, C, X, Y, Z, 29-E, and W135). Serogroups A, B, and C associated with epidemics.

AETIOLOGY

Meningococcal disease is a contagious disease caused by the meningococcus (Neisseria meningitidis), a Gram-negative bacterium.

RESERVOIR

Humans and asymptomatic carriage in nasopharynx is common.

MODE OF SPREAD

Person-to-person by direct contact with respiratory droplets of infected peoplemost cases acquired through exposure to asymptomatic carriers, relatively few through direct contact with patients with meningococcal disease.

INCUBATION PERIOD

1-10 days, usually <4 day

SYPMTOMS AND SIGNS

Sudden onset of intense headache, fever, nausea, vomiting, photophobia and stiff neck. In addition, neurological signs can be observed, such as lethargy, delirium, coma, and/or convulsions.

However, infants may have illness without sudden onset and stiff neck. Meningococcal septicaemia is difficult to recognize outside an epidemic: abrupt onset, fever and shock occur irregularly, petechial rash or purpura may not be obvious initially and meningeal symptoms are usually absent.

HOW TO PREVENT MENINGOCOCCAL DISEASE

Meningococcal disease is potentially preventable through vaccination and/or chemoprophylaxis in special circumstances.

2. LASSA FEVER

Lassa fever is an acute viral hemorrhagic fever first described in 1969 in the town of Lassa, in Borno State, Nigeria located in the Yedseram river valley at the south end of Lake Chad. The infection is endemic in West African countries, and causes 300-500,000 cases annually with approximately 5,000 deaths.

Prevalence

The dissemination of the infection can be assessed by prevalence of antibodies to the virus in populations of:
Sierra Leone 8–52%
Guinea 4–55%
Nigeria approx. 21%

Like other hemorrhagic fevers, Lassa fever can be transmitted directly from one human to another. It can be contracted by an airborne route or with direct contact with infected human blood, urine, or semen. Transmission through breast milk has also been observed.

Prevention

Control of the "Mastomys" rodent population is impractical, so measures are limited to keeping rodents out of homes and food supplies, as well as maintaining effective personal hygiene. Gloves, masks, laboratory coats, and goggles are advised while in contact with an infected person.

Symptoms

In 80% of cases the disease is inapparent, but in the remaining 20% it takes a complicated course. It is estimated that the virus is responsible for about 5,000 deaths annually. After an incubation period of six to twenty-one days, an acute illness with multi-organ involvement develops. Non-specific symptoms include fever, facial swelling, and muscle fatigue, as well as conjunctivitis and mucosal bleeding. The other symptoms arising from the affected organs are:

Gastrointestinal tract (Nausea, Vomiting (bloody), Diarrhea (bloody), Stomach ache, Constipation, Dysphagia (difficulty

swallowing), Hepatitis, Cardiovascular system (Pericarditis, Hypertension, Hypotension, Tachycardia (abnormally high heart rate), Respiratory tract (Cough, Chest pain,Dyspnoea, Pharyngitis, Pleuritis Nervous system (Encephalitis, Meningitis, Unilateral or bilateral hearing deficit, Seizures Clinically, Lassa fever infections are difficult to distinguish from other viral hemorrhagic fevers such as Ebola and Marburg, and from more common febrile illnesses such as malaria.

The virus is excreted in urine for three to nine weeks and in semen for three months.

Diagnosis

ELISA test for antigen and IgM antibodies gives 88% sensitivity and 90% specificity for the presence of the infection. Other laboratory findings in Lassa fever include lymphopenia (low white blood cell count), thrombocytopenia (low platelets), and elevated aspartate aminotransferase (AST) levels in the blood.

Prognosis

About 15%-20% of hospitalized Lassa fever patients will die from the illness. It is estimated that the overall mortality rate is 1%, however during epidemics mortality can climb as high as 50%.

Treatment

All persons suspected of Lassa fever infection should be admitted to isolation facilities and their body fluids and excreta properly disposed of. Early and aggressive treatment using Ribavirin was pioneered by Joe McCormick in 1979.

3. MEASLES

Measles is a highly contagious, serious disease caused by a virus. In 1980, before widespread vaccination, measles caused an estimated 2.6 million deaths each year.

It remains one of the leading causes of death among young children globally, despite the availability of a safe and effective vaccine. Approximately 122000 people died from measles in 2012 – mostly children under the age of five.

Measles is caused by a virus in the paramyxovirus family.

Signs and symptoms

Fever, runny nose, a cough, red and watery eyes, and small white spots (Koplik's spots). After several days, a rash erupts, usually on the face and upper neck. Over about three days, the rash spreads, eventually reaching the hands and feet. The rash lasts for 5 to 6 days, and then fades. On average, the rash occurs 14 days after exposure to the virus (within a range of seven to 18 days).

Transmission

The highly contagious virus is spread by coughing and sneezing, close personal contact or direct contact with infected nasal or throat secretions.

Treatment

No specific antiviral treatment exists for measles virus.

Prevention: Routine measles vaccination for children combined with mass immunization campaigns in countries with high case and death rates, are key public health strategies to reduce global measles deaths.

4. CHOLERA

Cholera is an acute diarrhoeal infection caused by ingestion of food or water contaminated with the bacterium Vibrio cholerae. Every year, there are an estimated 3–5 million cholera cases and 100 000–120 000 deaths due to cholera. The short incubation period of two hours to five days, enhances the potentially explosive pattern of outbreaks.

Signs and Symptoms: profuse watery diarrhea with or without vomiting and abdominal pain/ cramps

Risk factors and disease burden: Cholera transmission is closely linked to inadequate environmental management. Typical at-risk areas include peri-urban slums, where basic infrastructure is not available, as well as camps for internally displaced people or refugees, where minimum requirements of clean water and sanitation are not met.

Prevention and control

A multidisciplinary approach based on prevention, preparedness and response, along with an efficient surveillance system, is key for mitigating cholera outbreaks, controlling cholera in endemic areas and reducing deaths.

Treatment

Cholera is an easily treatable disease. Up to 80% of people can be treated successfully through prompt administration of oral rehydration salts (WHO/UNICEF ORS standard sachet). Very severely dehydrated patients require administration of intravenous fluids. Such patients also require appropriate antibiotics to diminish the duration of diarrhoea, reduce the volume of rehydration fluids needed, and shorten the duration of V. cholerae excretion. Mass administration of antibiotics is not recommended, as it has no effect on the spread of cholera and contributes to increasing antimicrobial resistance.

5. YELLOW FEVER

Yellow fever is a serious viral infection that's usually spread by a type of mosquito known as the Aedes aegypti mosquito. It can be prevented with a vaccination. It mainly occurs in sub-Saharan Africa (countries to the south of the Sahara desert), South America and in parts of the Caribbean.

There have not been any recent cases of yellow fever in North America, Europe or Asia. Since 1996, six travellers from Europe and North America have died from the infection. None of them were vaccinated.

Signs and symptoms

Incubation period = 3 to 6 days,

Fever, muscle pain with prominent backache, headache, shivers, loss of appetite, and nausea or vomiting. Most patients improve and their symptoms disappear after 3 to 4 days.

Treatment

There is no specific treatment for yellow fever, only supportive care to treat dehydration, respiratory failure and fever.

Prevention

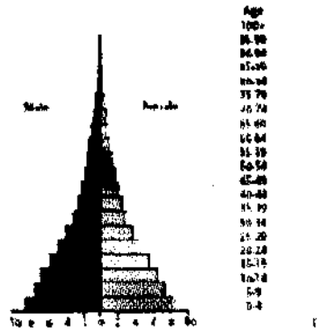
1. Vaccination

Vaccination is the single most important measure for preventing yellow fever. In high risk areas where vaccination coverage is low, prompt recognition and control of outbreaks through immunization is critical to prevent epidemics. To prevent outbreaks throughout affected regions, vaccination coverage must reach at least 60% to 80% of a population at risk. Few endemic countries that recently benefited from a preventive mass vaccination campaign in Africa currently have this level of coverage.

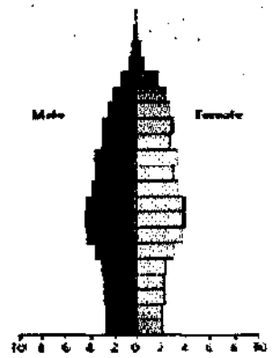
6. THE EFFECTS AND CONSEQUENCES OF EPIDEMICS

Medical effects:
Increased morbidity,
Increased mortality,
Increases disability
Interruption of basic public health services,

Demographic effects:
Population displacement
Changes in density of population



Rapid population growth –pre epidemic –post



Rapid population growth epidemic

Socio-economic effects:

- Decreased population in the productive age group with attendant decrease in productivity
- Disruption of public utilities such as banks, markets, etc
- Use of financial resources in control of epidemics. These resources will have channeled for other developmental projects
- It also creates an avenue for corruption through diversion of resources meant for control of epidemics

Consequences on international relations & travels:

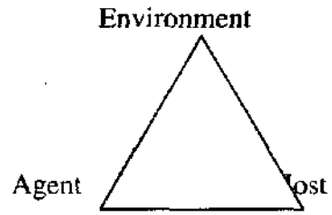
- Restriction of travels, e.g. in the year 1996/97, Saudi Arabian Government banned Nigerian pilgrims from entry into Saudi Arabia due to outbreak of cholera in some Nigerian States

- Unnecessary quarantine & humiliation of travelers

7. THE TRADITIONAL APPROACHES TO THE CONTROL OF EPIDEMICS

Principles of epidemic control

The process of anticipating, preventing, preparing for, detecting, responding and controlling outbreaks in order that the health and economic impact is minimised is termed outbreak management. Diseases are caused by interplay of three major factors: agent, host and environment. These three factors are referred to as epidemiologic triad. This model has helped epidemiologists in analysing different outbreak situations especially with regard to infectious diseases. The agent, host and favourable environment factors operating in combination determine not only onset of disease which may range from a single case of disease to epidemics, but also the distribution of the disease in the community



Agent factors: disease agents may be broadly classified into biological agents such as bacteria, viruses, etc; nutrient agents (proteins, fats, carbohydrates, etc), physical agents (excessive heat, cold, humidity, etc), chemical agents (urea, ketones, allergens, fumes, gases, etc), mechanical agents (friction, mechanical force, etc), absence/insufficiency/excess of a factor necessary to health (chromosomes, immunological factors, enzymes) and social agents (poverty, smoking, drug abuse, etc).

Host factors:

The host factors: may be classified as demographic, biological, socio-economic and life style factors.

Environmental factors: the environment of man has been divided into three components: physical, biological and

psychosocial. However, this separation is only artificial as they are closely related to each other and with host factors.

Traditional approaches to containing outbreaks were defensive, trying to secure borders from the entry of infectious diseases.

Modern solutions, in addition to the development of new anti-infective drugs and vaccines, are built on a combination of early warning surveillance systems, epidemic preparedness plans, and stockpiles of essential materials, speedy communications and information sharing through networks to rapidly contain epidemic threat.

Control of epidemics

To control epidemic, one must have information with respect to:

- Causative organism/source,
- Dynamic of disease transmission,
- Mode of transmission and
- Route of transmission

Three principles of dynamics of disease transmission are used to control epidemics, namely:

- Removal of source of infection,
- Prevent transmission, and
- Vector control measures

Removal of source of infection: this comprises of the following:

- Treatment of infected cases,
- Destruction of reservoir of infection, and
- Removal/correction of source of infection

Prevent transmission:

- Isolation of infected cases
- Hand washing and use of personal protective equipment
- Use of sterile supply
- Proper disposal of fomites
- Improved environmental sanitation
- Contact tracing
- Screening of suspected cases
- Quarantine of migrated cases
- Health education
- Increased resistance of suspects e.g. through immunization, prophylaxis, etc

Vector control measures:

- Prevent breeding of mosquitoes, flies, fleas, etc
- Destruction of adult vectors through the use of insecticides, pesticides, etc
- Personal protection from bites
- Increased personal hygiene
- Improved environmental sanitation

Prevention of epidemics

Epidemic prevention measures include:

Personal measures:

- Increase body resistance e.g. through immunization
- Change in diet habits
- Regular exercise
- Etc

Environmental measures

- Improved environmental sanitation
- Provision of adequate potable water supply
- Proper refuse/sewage disposal

Regular health education to people through mass media, meetings, seminars, etc

Epidemic preparedness and response (EPR): Epidemic Preparedness constitutes all the activities that have to be undertaken for central/peripheral levels to be ready to respond effectively to epidemics/outbreaks. When all the activities are put together in a plan then we have an Epidemic Preparedness Plan.

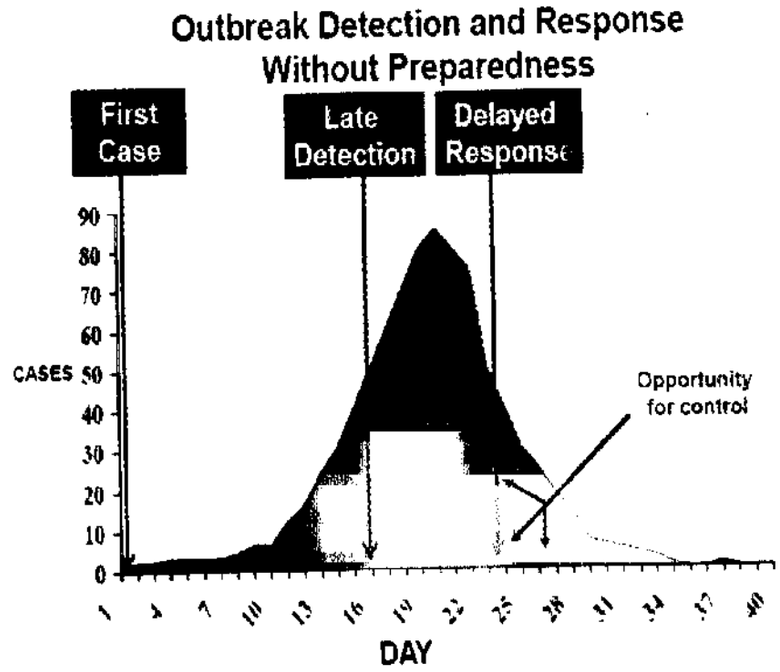
The objectives of EPR are:

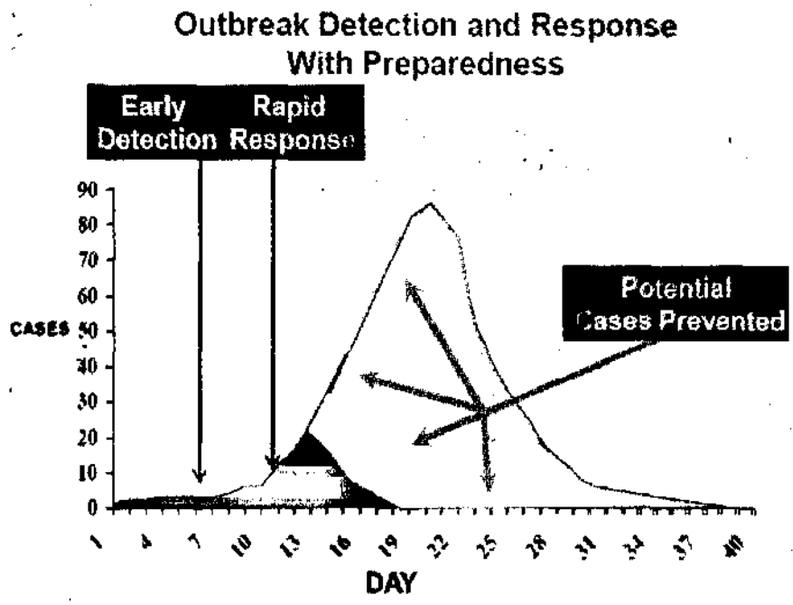
1. **Anticipation/prediction** so that epidemics can be prevented e.g. meningitis, measles
2. **Preparedness** so there is readiness to respond.
3. **Early detection** to know when there is a problem.
4. **Rapid Response:** this ensures that guidelines/trained staff/supplies are in place before epidemic.

5. **Effective Response** by adopting appropriate control methods and ensuring that adequate resources and logistics are available.
6. **Evaluation** to identify what went right and what went wrong before and during the outbreak.

The elements of epidemic preparedness are as follows:

- ✓ Ensure that routine surveillance system can detect outbreaks
- ✓ Ensure that staff are organized to confirm, investigate, and respond to outbreaks
- ✓ Maintain buffer stocks of drugs, essential equipment, materials and supplies
- ✓ Ensure financial support for preparation and response





Steps of epidemic investigation and control

The occurrence of an epidemic always signals some significant shift in the existing balance between agent, host and environment. It calls for a prompt and thorough investigation of the cases to find out the factors responsible and to guide in advocating control measures to prevent further spread. The objectives of epidemic investigation are:

a. To define the magnitude of the epidemic or involvement in terms of time, place and person,
b. To determine particular conditions and factors responsible for the occurrence of the epidemic
c. To identify cause, source(s) of infection, and modes of transmission to determine measures necessary to control the epidemic; and
d. To make recommendations to prevent recurrence.

There are 10 major steps for investigating and controlling epidemics:

1. Verify the diagnosis: This is the first step in outbreak investigation, as it may happen sometimes that the report may be spurious, and arise from misinterpretation of signs and symptoms by the lay public. Here, clinical and laboratory studies will help to confirm the diagnosis of the disease in question.

2. Establish the existence of an outbreak: attempt to compare the current incidence with past levels of the disease will help to determine whether an excessive number of cases have occurred.

3. Describe the epidemic with respect to person, place and time: Here, the cases are counted to determine the frequency. A graph of cases by time of onset need to be plotted (epidemic curve). A graph of cases by location also needs to be plotted (spot map). Rates of illness in population at risk by age, sex, occupation, exposure to specific food items, and other relevant attributes need to be calculated.

4. Formulate a hypothesis: Identify the type of epidemic-common source or propagated. After defining the population that has been at the highest risk of acquiring the diseases, consider the possible source(s) from which the disease may have been contracted. Compare ill populations (cases) with well population (controls) with regard to exposure to the postulated source. Determine relative risk for exposed and non-exposed persons.

5. Search for additional cases and their characteristics: This can be achieved via medical surveys, epidemiological case sheet and active search for more cases.

6. Analyse data: the data collected should be analysed on an on-going bases using the classical epidemiological parameters: time, place and person.

7. Testing hypothesis: all reasonable hypotheses need to be considered and weighed by comparing the attack rates in various groups for those exposed and for those not exposed to each factor.

8. Plan a more systematic study: a study of the population at risk or a sample of it may be needed to obtain additional information. The approach may be retrospective or prospective.

9. Execute control and prevention measures: It may be necessary to implement temporary control measures at the commencement of an epidemic on the basis of known facts of the disease. These measures may be modified or replaced in the light of new knowledge acquired from the epidemic investigation.

10. Prepare a written report: at the end of the investigation, a report is usually prepared and submitted to appropriate authorities. This report includes discussion of factors leading to the epidemic, evaluation of measures used for control and recommendations for preventing similar episodes in future.

Main actors of epidemic control

The actors involved in investigation and control of epidemics comprise of the following:

Epidemiologist
Clinician (pathologist)
Microbiologist/laboratory scientist
Environmental specialist
Veterinarian
Toxicologist
Auxiliaries: e.g. nurses, drivers, etc
Ministry of Health
Press officer
Others

8. THE EMERGING TRENDS OF EPIDEMICS

Avian Influenza (H_5N_1)

Avian influenza refers to a large group of different influenza viruses that primarily affects birds. On rare occasions, these bird viruses can infect other species such as humans and pigs. H_5N_1 strain is a strain with pandemic potential, since it might ultimately adapt into a strain that is contagious among humans. The H_5N_1 strain first infected humans in Hong Kong in 1997, causing 18 cases including 6 deaths. Since mid 2003, this virus has caused the largest and most severe outbreaks in poultry on record. In December 2003, infections in people exposed to sick birds were identified.

Epidemiological determinants of Avian Influenza

Agent factors: Influenza viruses belong to the family orthomyxoviridae. There are 3 viral sub types: influenza types A, B and C. The 3 viruses are antigenically distinct and there is no cross immunity between them. Influenza types A and B are responsible for most epidemics globally.

Both influenza types A and B have 2 distinct surface antigens: haemaglutinin (H) and neuraminidase (N). The H antigen initiates infection while the N antigen is responsible for the release of the virus from the infected cell.

Host factors:

a. Age and sex: Influenza affects all ages and box sexes. In general attack rate is lower among adults. The highest mortality rate during epidemics is seen among certain high risk groups such as old people, children under 18 months, and persons with diabetes and chronic heart disease.
b. Human mobility: is an important factor in the spread of the disease.
c. Immunity: immunity to influenza is sub type specific. Antibodies against H and N antigens are important in immunity to influenza. A person with low titres of the antibodies may be infected but will experience a mild form of the illness.

Environmental factors:

a. There is seasonal variation in the occurrence of the epidemics. The epidemics are commoner in winter months in the northern hemisphere and in the winter or rainy season in the southern hemisphere.
b. Over-crowding: It enhances transmission.

Mode of transmission

Influenza is mainly transmitted from person to person by droplet infection or droplet nuclei created by sneezing, coughing or talking. The portal of entry of the virus is respiratory tract.

Incubation period: 18 to 72 hours

Diagnosis

This is achieved via (a) viral isolation or (b) Paired sera test using complement fixing antibodies.

Prevention

All attempts to control influenza epidemics have so far met with little success and the prospects of achieving control remain poor. However, the following will minimize occurrence and spread of outbreaks:

- Good ventilation of public buildings,
- Avoidance of crowded places especially during epidemics,
- Encouraging sufferers to cover their faces with handkerchief when coughing or sneezing,
- Staying at home after noticing first signs of influenza,
- Hygienic practices during handling of poultry/poultry products,
- Vaccination is not recommended for control of spread in general population

Swine flu (H_1N_1)

Swine flu is a relatively new strain of influenza (flu) that was responsible for a flu pandemic during 2009-2010. It is an infection caused by any one of several types of swine influenza viruses. It is also called **pig influenza**, **hog flu** and **pig flu. Swine influenza**

virus (SIV) or **swine-origin influenza virus (S-OIV)** is any strain of the influenza family of viruses that is endemic in pigs. As of 2009, the known SIV strains include influenza C and the subtypes of influenza A known as H1N1, H1N2, H2N1, H3N1, H3N2, and H2N3.

Swine influenza virus is common throughout pig populations worldwide. Transmission of the virus from pigs to humans is not common and does not always lead to human flu, often resulting only in the production of antibodies in the blood. If transmission does cause human flu, it is called zoonotic swine flu. People with regular exposure to pigs are at increased risk of swine flu infection.

Agent factors: Of the three genera of influenza viruses that cause human flu, two also cause influenza in pigs, with influenza A being common in pigs and influenza C being rare. Influenza B has not been reported in pigs. Within influenza A and influenza C, the strains found in pigs and humans are largely distinct, although because of reassortment there have been transfers of genes among strains crossing swine, avian, and human species boundaries. Influenza types A has 2 distinct surface antigens: haemaglutinin (H) and neuraminidase (N). The H antigen initiates infection while the N antigen is responsible for the release of the virus from the infected cell. There is no cross immunogenicity between influenza sub types A and C.

Transmission

Influenza is quite common in pigs. The main route of transmission among pigs is through direct contact between infected and uninfected animals. These close contacts are particularly common during animal transport. Intensive farming may also increase the risk of transmission, as the pigs are raised in very close proximity to each other.

People who work with poultry and swine, especially those with intense exposures, are at increased risk of zoonotic infection with influenza virus endemic in these animals, and constitute a population of human hosts in which zoonosis and reassortment can co-occur. Other professions at particular risk of infection are veterinarians and meat processing workers, although the risk of

infection for both of these groups is lower than that of farm workers.

Symptoms

The symptoms of swine flu are similar to those of influenza and of influenza-like illness in general. Symptoms include fever, cough, sore throat, body aches, headache, chills and fatigue. The 2009 outbreak has shown an increased percentage of patients reporting diarrhea and vomiting. The most common cause of death is respiratory failure. Other causes of death are pneumonia (leading to sepsis), high fever (leading to neurological problems), dehydration (from excessive vomiting and diarrhea), electrolyte imbalance and kidney failure. Fatalities are more likely in young children and the elderly.

Diagnosis

Real-time PCR is the method of choice for diagnosing H1N1. This method allows a specific diagnosis of novel influenza (H1N1) as opposed to seasonal influenza.

Prevention

Prevention of swine influenza has three components: prevention in swine, prevention of transmission to humans, and prevention of its spread among humans.

In swine

Methods of preventing the spread of influenza among swine include facility management, herd management, and vaccination. Because much of the illness and death associated with swine flu involves secondary infection by other pathogens, control strategies that rely on vaccination may be insufficient.

Facility management includes using disinfectants and ambient temperature to control viruses in the environment. They are unlikely to survive outside living cells for more than two weeks, except in cold (but above freezing) conditions, and are readily inactivated by disinfectants. Herd management includes not adding pigs carrying influenza to herds that have not been exposed to the virus. The virus survives in healthy carrier pigs for up to three months, and can be recovered from them between outbreaks.

Carrier pigs are usually responsible for the introduction of SIV into previously uninfected herds and countries, so new animals should be quarantined. After an outbreak, as immunity in exposed pigs wanes, new outbreaks of the same strain can occur.

In humans

Prevention of pig-to-human transmission

Swine can be infected by both avian and human flu strains of influenza, and therefore are hosts where the antigenic shifts can occur that create new influenza strains.

The transmission from swine to humans is believed to occur mainly in swine farms, where farmers are in close contact with live pigs. Although strains of swine influenza are usually not able to infect humans, this may occasionally happen, so farmers and veterinarians are encouraged to use face masks when dealing with infected animals. The use of vaccines on swine to prevent their infection is a major method of limiting swine-to-human transmission. Risk factors that may contribute to swine-to-human transmission include smoking and, especially, not wearing gloves when working with sick animals, thereby increasing the likelihood of subsequent hand-to-eye, hand-to-nose or hand-to-mouth transmission.

Prevention of human-to-human transmission

Influenza spreads between humans when infected people cough or sneeze, then other people breathe in the virus or touch something with the virus on it and then touch their own face. "Avoid touching your eyes, nose or mouth. Germs spread this way." Swine flu cannot be spread by pork products, since the virus is not transmitted through food. The swine flu in humans is most contagious during the first five days of the illness, although some people, most commonly children, can remain contagious for up to ten days. Diagnosis can be made by sending a specimen, collected during the first five days, for analysis.

Recommendations to prevent spread of the virus among humans include using standard infection control, which includes frequent washing of hands with soap and water or with alcohol-based hand sanitizers, especially after being out in public. Chance

of transmission is also reduced by disinfecting household surfaces, which can be done effectively with a diluted chlorine bleach solution. Experts agree hand-washing can help prevent viral infections, including ordinary and the swine flu infections. Also, avoiding touching one's eyes, nose or mouth with one's hands helps to prevent the flu. Influenza can spread in coughs or sneezes, but an increasing body of evidence shows small droplets containing the virus can linger on tabletops, telephones and other surfaces and be transferred via the fingers to the eyes, nose or mouth. Alcohol-based gel or foam hand sanitizers work well to destroy viruses and bacteria. Anyone with flu-like symptoms, such as a sudden fever, cough or muscle aches, should stay away from work or public transportation, and should seek medical advice.

Social distancing, another tactic, is staying away from other people who might be infected, and can include avoiding large gatherings, spreading out a little at work, or perhaps staying home and lying low if an infection is spreading in a community. Public health and other responsible authorities have action plans which may request or require social distancing actions, depending on the severity of the outbreak.

The increasing incidence of Animal to man transmission of diseases call for paradigm shift and change of status quo in the way and manner epidemics are investigated and respond to in the country. This brings us to the concept of one health.

9. THE CONCEPT OF ONE HEALTH

One health is where there is convergence of Human - Animal – Environment interface. It is the collaborative effort of multiple disciplines working locally, nationally and even globally to attain health of humans, animals and our environment. As once said by a German physician of high reputation by name Rudolf Virchow (1821 – 1902) "between animal and human medicine there are no dividing lines ------ nor should there be"

Why is one health

Julie Gerberding Director CDC during a news conference in 2004 was quoted as saying twelve out of the last thirteen human emerging infectious diseases I the world have arisen from animal's

sources. So what we really need to work on is the relationship between the human health surveillance system and the animal health surveillance systems. One very important point of intersection is the laboratories. We have to do more to share our laboratory capacities.

The focus of one health

When we focus on one health we can diminish the threat and minimize the national and global impact of diseases of animal origin including Zoonosis and those with pandemic potentials like H5N1 and H1N1. The strategic elements to follow should focus around the following:

a) Dealing with the root cause and drivers of infectious diseases particularly at the animal human ecosystem interface
b) Building robust and well governed public and animal health systems (WHO International Health Regulation)
c) We also need to build national and international emergency response agencies.
d) Promoting wide ranging collaboration across sectors and disciplines is also encourage
e) Developing targeted and national disease control programs through strategic research

10. THE NIGERIAN RESPONSE TO ONE HEALTH INITIATIVE

All stakeholders in the business of disease surveillance in this country agreed to the concept of one health as a viable alternative for this in other to improve the desired surveillance and response in the country. This was made possible due to the lesson learnt from the handling of the H5N1 epidemics in the country and later H1N1. The concept emphasized the need for collaboration of all the necessary stakeholders for an improvement on the way and manner the surveillance and response are being organized in the country.

NFELTP was conceived
How it all stated in Nigeria

The first meeting on the proposed NFELTP was held in January 2007, between CDC and FMOH. In march, 2007, a team of experts came from CDC Atlanta, CDC South Africa, CDC Zimbabwe and CDC Nigeria for an assessment visit. They paid a courtesy call to Hon. Minister of State for health and Conducted stakeholders workshop (FMOH, FMARD, NIMR, SMOH, Universities, NUC, NAVRC Enugu, NTBLTC –Zaria, CDC on 12th and 13th March, 2007. The steering committee for the NFELTP was inaugurated by Hon. Minister of Health on the 14th March, 2007.



First multi-sectoral steering committee launched by the Honourable Minister of Health in March 2007

NFELTP is a service oriented, completely based training program. It is a two year full time training in applied epidemiology. Veterinary epidemiology and Laboratory, epidemiology and Management. It puts a lot of emphasis on Service. The Field epidemiology Component is similar to other Field Epidemiology Training programmes that are modeled after the Epidemic Intelligence Service (EIS) programme of the United States Centre for Disease Control (CDC) in Atlanta. The laboratory component is based on CDC's emerging infections programme. The Nigerian

programme is the first to introduce the Veterinary Component. The NFELTP is tailored to strengthen public health capacity in accordance with the Nigerian's culture, national priorities, establishing relationships as well as the existing public health infrastructures.

The primary objectives of NFELTP are as follows:

- Training leaders in applied epidemiology and public health laboratory practice. The emphasis is on problem solving issues of public health concern.
- Proving epidemiologic services to the federal, state and local government health authorities in Nigeria.

Other secondary objectives include:

- Strengthening capacity to respond to public health emergencies such as outbreaks, epidemics, natural disasters and emerging infectious disease.
- Strengthening public health and veterinary surveillance system.
- Strengthening laboratory participation in surveillance and field investigations.
- Strengthening the linkage between public health and veterinary epidemiology.
- Conducting research activities on priority public health problem.
- Improving communications and networking within the Nigeria and throughout the region.
- Strengthening affiliations with the international organization such as the TEPHINET and AFENET as well as other FELTP.

Vision of the Programme

To become a lead training programme for improving the health of the people of Nigeria and beyond by addressing Nigerians public health needs and priorities through training and service provision in applied epidemiology and laboratory management.

Mission of the Programme

To assist the Federal Ministry of Health and the Federal Ministry of Agriculture in building a sustainable network of highly skilled field epidemiologist, Veterinarians and laboratory managers who are measurably improving public health services through:

- Strengthening Nigerians public health capacity by developing a cadre of health professionals with advance skills in applied epidemiology and laboratory management.
- Contributing effectively to research activities on priority public health problem.
- Improving Nigeria's national and regional capacity to respond to public health emergencies such as disease outbreak, natural disasters and other unusual public health event including those that could be the results of chemical or biological terrorism.
- Boosting Nigeria's national disease and veterinary surveillance system.

Implementing Partners for the Programme

These include the following:

- (FMOH) – Federal Ministry of Health
- (FMOA) - Federal Ministry of Agriculture
- Ahmadu Bello university (ABU)
- University of Ibadan (UI)
- Nigerian Centre for Disease Control (NCDC)
- United State Centres for Disease Control and Prevention in Atlanta
- African Field Epidemiology Network (AFENET)
- World Health Organisation (WHO)

Governance Structure

There is a steering committee that oversees the implementation of the NFELTP programme in the country where all the partners are represented. There is a director and resident Advisor that see the day to day running of the programme in the Federal Ministry of Health. There are also focal desk in all the partner organisations that help run the programme affectively.

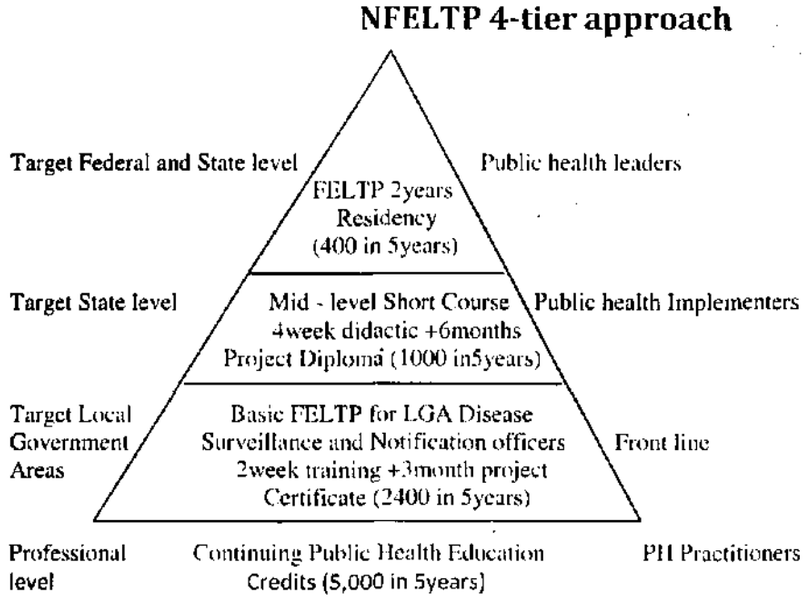


Figure 1:

11. THE ROLE OF TERTIARY INSTITUTIONS

Under FELTP arrangement universities are supposed to be centers for Human capital development of the critical mass of professionals to fight against the epidemics. To this effect ABU and UI were selected for this task. To achieve this objective the universities embarked on purposeful actions that span through following.

(a) Curriculum development

The curriculum of NFELTP programme was developed through series of activities that started with the review of the E.I.S curriculum, working with the FMOH to get the priorities of government and the various NUC requirements. All these were synchronized to come up with a befitting curriculum that prescribe 25% class room activities that include teaching and 75% field placement to ensure skill acquisitions and utilization of knowledge already acquired during the class room activities.

(b) Teaching and Supervision

The teaching of the curriculum of NFELTP are being done by the faculty from the University as well as faculty from university of Ibadan and we also get guest lecturers from the FMOH, FMARD as well as technical support from experts from CDC and AFENET. In addition to these teachings, the faculty also embarks on field supervision of students in their various field site quarterly.

Accreditation of Field Sites

All the field training sites are usually accredited by the university and the FMOH and
FAMARD to ensure that all students are exposed to the critical deliverables requirements for solving problem.

Admission of the Candidate

All candidates for the programme are expected to purchase the admission forms from the University post graduate school and also sit for the screening examination and interview. The selection is usually done by a special selection committee.

12. THE SUCCESSES RECORDED

(a) Capacity Building

NFELTP trainees and graduates 2008 – 2014

NFELTP main goal is to build applied epidemiology capacity as well as public health leaders and implementers across all the states in the country. The program's long course is modeled after the CDC Epidemic Intelligence Service (EIS) program, which is a 2 year training program responsible for public health workforce development in the US public health system.

NFELTP's 2 year long course component leads to a Masters in Public Health (Field Epidemiology) from 2 leading Universities (Ahmadu Bello University and University of Ibadan). We also run a 6 month (1 month didactic and 5 month field project) and a 3 month (2 weeks didactic and 3 month field project) short courses.

1. Long course admissions and graduations (2008 – 2014)
(2 year Masters in Public Health in field epidemiology)

Year of admission	Year of completion	Number Admitted	Number Graduated	Comments
2008	2010	13	13	Inaugural cohort
2009	2012	13	12	Death of one resident, delayed completion due to university strike
2011	2014	39	35	Delay in admission due to funding delay, delay in completion due to university strike. Three residents dropped out as a result of medical or personal challenges
2012	2014	40		Expected to complete in June 2014
2013	2015	49		Expected to complete in 2015
2014	2016	53		Expected to complete in 2016
Total		**207**	**60**	

2. Short course 6 month course on Professional HIV/AIDs Program Management Short Course through an EFMC

Year of admission	Year of completion	Number Admitted	Number Graduated	Comments
April 2013	**September 2013**	**47**	**44**	**Trained on HIV/AIDs epidemiology, surveillance, program management, monitoring and evaluation. Conducted 2 competency-based field projects**

3. Short courses – 3 month – assorted

Type of short course	Month/Year	Persons trained	Venue	Comments
HIV competency-based Monitoring and evaluation	July-October 2012	75	Abuja	Competency based monitoring and evaluation of programs with emphasis on HIV. Course done through EFMC
Outbreak investigation	November 2011	40	Ibadan	State RRT trained on outbreak investigation – funded by FMOH
Outbreak investigation	September 2011	35	Minna	State RRT trained on outbreak investigation – funded by FMOH
Outbreak investigation	June 2011	33	Kaduna	State RRT trained on outbreak investigation – funded by FMOH
Basic epidemiology course and health leadership and management	January 2011	87	Sokoto	Equipping frontline health care workers with basic epidemiology and health leadership and management skills in northern Nigeria – funded by US Department of Health & Human Services– Health Diplomacy
Zoonoses outbreak and surveillance Short course	September 2010	32	Vom	Zoonoses surveillance and outbreak – USAID funded
Outbreak and surveillance	July – October 2008	35	Minna	State epidemiologists training on outbreak investigation and surveillance with emphasis on vaccine preventable diseases
HIV/TB collaboration (2 courses)	2007/08	66	Zaria, Sokoto	HIV/TB epidemiology and collaboration, data analysis
Outbreak and surveillance (2 courses)	2007/8	70	Enugu Lagos	Emphasis on surveillance and outbreak investigation on influenza and vaccine preventable diseases-supported by GID and USAID

Total of 517 on 3 month short courses on HIV/TB collaborations, zoonoses, outbreak investigation and surveillance

NFELTP residents by Zone 2008-2014 (207)

Zone	Number	PER 1 MILLION POPULATION	% COVERAGE***
North West	42	[illegible]	23%
North Central	44	1.83	36%
South West	40	1.21	24%
North East	31	1.41	28%
South East	32	1.78	36%
South South	18	0.90	18%
Total	**207**	**1.34**	**27%**

***Recommendation = 5 epidemiologist per 1 million population

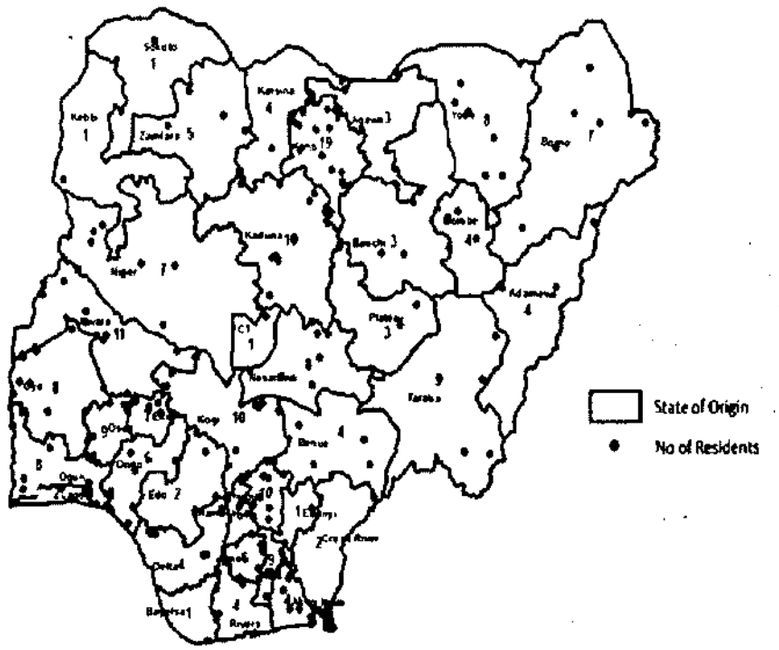
Cohort 6 selection

Univ	Med	Vet	Lab	Total
UI	16	3	6	25
ABU	18	3	8	29
Total	34	6	14	54

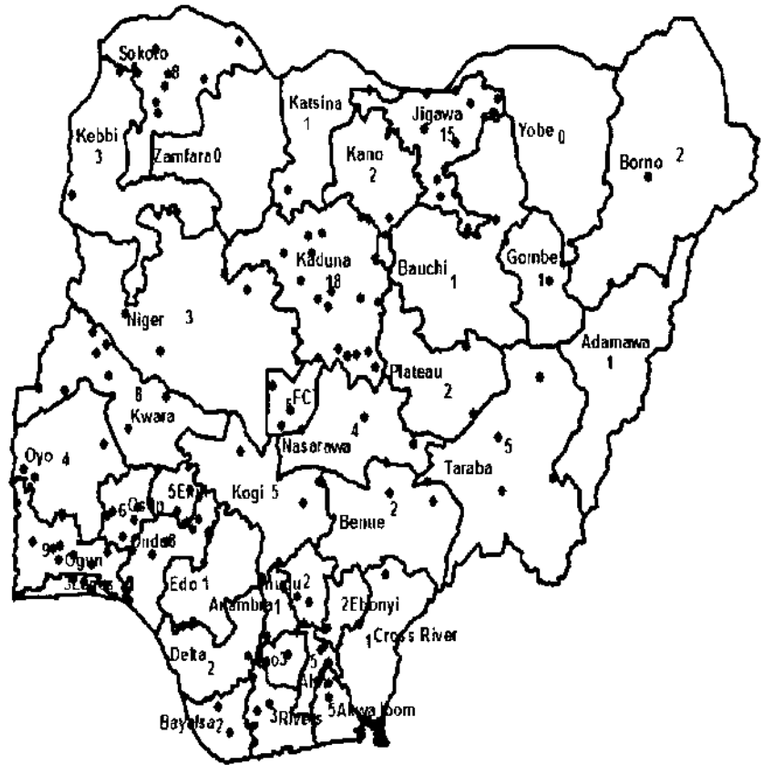
- **300 applied**
- **160 shortlisted**
- **140 interviewed**
- **54 selected**
- **13(24%) females**
- **From 25 states**

Analysis By State of Origin (N=207)

ALL States have at least 1 resident



Analysis by Place of Work: State Level (N= 148) 35 States have at least 1 resident


Sokoto
Katsina
1
Jigawa
15
Yobe 0
Kebbi
3
Zamfara 0
Kano
2
Borno 2
Kaduna
18
Bauchi 1
Gombe
1
Niger 3
Adamawa
1
Plateau
2
FC
Kwara
Nasarawa
4
Taraba
Oyo 4
Kogi 5
Benue
2
Ogun
Edo 1
Anambra 1
2Ebonyi
Cross River
Delta 2
Bayelsa 2
3Rivers
5Akwa Ibom

Analysis by place of work – Federal Level (N=59)

Place of Work	Residents
FMOH	40
FMARD	7
NVRI	6
ABU	2
UI	1
Nigeria customs	1
NPHCDA	2

Number of Residents by University

Cohort	Ahmadu Bello	University of Ibadan	Total
1 - 2008	10	3	13
2 - 2009	13	0	13
3 - 2010	30	9	39
4 - 2011	31	9	40
5 - 2012	30	19	49
6-2013	28	25	53
Total	**142 (69%)**	**65 (31%)**	**207**

Number of Residents 2008 - 2014

Cohort - Year of admission	Medical	Veterinary	Laboratory	Total
1 - 2008	6	4	3	13
2 - 2009	6	4	3	13
3 - 2010	17	13	9	39
4 - 2011	24	2	14	40
5 - 2012	33	4	12	49
6-2013	34	6	13	53
Total	120 (58%)	33 (16%)	54 (26%)	207

First Cohort completion



Third cohort NFELTP



(a) Surveillance System:

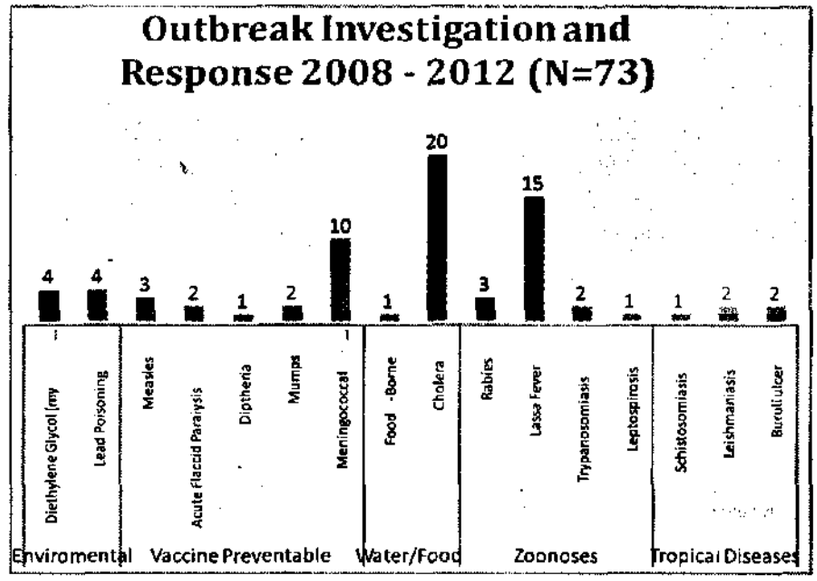
1. Integrated Disease Surveillance and Responses
   - ❖ Capacity building
   - ❖ Data analysis and feedback
   - ❖ Evaluation
   - ❖ Malaria
2. Animal Disease Surveillance System.
   - o Evaluation
   - o Rabies
   - o Live bird Markets
3. Human Immune Deficiency Virus (HIV)
   - ✓ ANC Sentinel surveillance
   - ✓ Integrated Biological and Behavioural survey
   - ✓ Most at Risk populations (Men who have sex with Men) (MSM)
   - ✓ PMTCT.

(c) One health Activities

1. Collaboration between human, animal and environment. (Epidemiological triangle). NFELTP is a collaboration initiative.
2. Rabies
    - Dogs bite victim description
    - PEP completion studies
    - Investigations, canine vaccinations in Cross River State
3. Food safety
4. Brucellosis – document gaps in abattoir diagnosis
5. Animal Human Interface – Bat studies

(d) Polio Activities

1. Creation of National Stop transmission of Polio (NSTOP) to build capacity and offer service.
2. Identification of under scored population.
3. Micro-planning for campaign in the high risk states/ LGA.
4. Strengthening surveillance.
5. Outbreak investigations for polio and other vaccines preventable diseases.
6. Data management and technical support for State operations Centres particularly with inter-campaign dash board monitoring.
7. Operational research
    - Evaluation of cold chain (Forward and Reverse)
    - Characterization of Chronically IPD missed children



Response to Public Health Emergencies

- Acute Renal failure outbreak
  - Identification of contaminant
  - Refining public health messages
- Cerebrospinal meningitis
  - Enhanced surveillance
  - Micro planning – vaccination
- Cholera outbreaks
  - Identification of risk factors for transmission
  - Cross border control activities
  - Cholera preparedness – Niger, Adamawa, oyo
- Rabies
  - Better collaboration between human and animal health sectors in surveillance and response
- Leptospirosis
  - Risk Factors
- Lassa fever - nosocomial spread, KAP, impact on ART
- Lead poisoning outbreak – Environmental, Risk factors, Magnitude/prevalence, characterize in animal tissue

Table: Protocol Based Research Studies Conducted by First 2 cohorts (n=26)

Type	Number	Details
Vaccination assessment	2	Coverage , Chronically missed
Measles	1	Risk Factors
Surveillance (Animal, Human, Lab)	4	Assessment , performance, QSE
Cholera	1	Risk Factors
Malaria	2	Treatment access, RDT Validity
Road Traffic Injuries	1	Characterization (Motor Cycles)
Hepatitis	1	Prevalence in ANC setting
Brucellosis	3	Abattoirs, Febrile illnesses
HIV	2	PMCT , Disclosure
Schistosomiasis	1	Prevalence and co-morbidity
Influenza	1	Prevalence and characterization
Rabies	1	Food safety
Human African Typanosomiasis	1	Prevalence
Tick-Borne Relapsing Fever	1	In human, ticks and animals
Tuberculosis	4	Bovine, Treatment outcomes, treatment access, sputum conversion
Total	**26**	

Assessments

- Seatbelt use assessment in Abuja
  - Usage rate 68%
  - Lower ; commercial, outside city centre, weekend
- Strengthening various surveillance systems
  - Evaluations
  - Data analysis
- Laboratory assessment for epidemic preparedness

Recent Field Deployments

- November 2012
  - Supporting creation of flood disaster EWARN, EOC, Anambra gastroenteritis among IDP
  - HIV – DQA/SQA, ART outcome evaluation
  - Support to IPD, Routine Immunization assessment ,
- October 2012

  - Rabies outbreak in cross rivers, Lassa fever Oyo, Lagos, Plateau
- August 2012
  - Nomadic outreach , IPDs , HIV protocol development
- July 2012
  - Cholera surveillance and preparedness assessment – 2 states
- June 2012
  - 14 residents involved in Immunization Plus Day preparations in 7 states
- Micro-plans improvement – reaching nomadic communities
- June 2012
  - Measles outbreak in Sokoto state
- May 2012
  - Suspected HAT in Kaduna state
- May 2012
  - Lead poisoning cluster survey Zamfara state
- March 2012
  - Lassa fever outbreak in Taraba state
  - Assessment of infection control practices – nosocomial spread
  - Impact of Lassa fever on HIV program
- Jan- February 2012 - Lassa fever outbreaks – Ebonyi, Nasarawa , Rivers , Lagos,

Other achievements

- Support to other programs
  - Cameroun, S/Leone, B/Faso, Rwanda ,South Caucasus, one health fellowship /EPT
- International conferences
  - AFENET – Addis Ababa – won 1st and 2nd best oral poster presentations
  - TEPHINET Conference – 7 posters , 8 orals – Jordan
  - ICID – Bangkok Thailand (1 poster)
  - 61st EIS 2012 – Atlanta USA (1 oral , 1 poster) – best oral presenter
  - EPISON conference – Calabar , Nigeria – 5 orals , 8 poster

- 5th AFENET – Dar es salaam Tanzania (8 orals , 5 poster) – best outbreak investigation
- ESCAIDE – 2011 – 1 oral
- ASTMH – 1 poster
- ISID – NTD – Boston USA – 1 oral , 3 posters
- IMED – February 2011 – Vienna Austria (3 posters)
- TEPHINET Global December 2010– Cape Town , South Africa(4 orals ,5 posters)
  Won 3rd prizes for both oral and poster
- ESCAIDE November 2010 –Lisbon Portugal (2 orals , 4 posters)
- EIS April 2010 – Atlanta USA(1 oral)
- ICID March 2010 – Miami USA (1 poster)
- NID October 2010 (3 orals , 4 posters)
- ICEID conference – Atlanta USA(1 oral , 3 poster)
- HIV national conference May 2010 – Abuja (1 poster)
- EIS April 2009 – Atlanta USA (1 poster)
- AFENET/TEPHINET; Mombasa September 2009(6 orals ,11 posters) ;
  3rd best oral
  - Institutionalization within the ministries; collaborations
  - Recognition by Global Outbreak Alert & Response Network(GOARN)

(e) <u>Publications</u>

Over 40 publications in peer review journals.

1. O Biya, S.Gidado, S.Haladu, P Nguku, J Durant, LB Davis, MJ Brown, A Neri, C Dooyema; Notes From the Field :Outbreak of Acute Lead Poisoning Among Children Aged <5years -----Zamfara , Nigeria ,2010; MMWR
2. A Abubukar, E Awosanya, O Badaru, S Haladu, P Nguku, P Edwards, R Noe, M Teran-Maciver, A Wolkin, L Lewis, M Nguyen; Fatal Poisoning Among Young Children from Diethylene Glycol-Contaminated Acetaminophen --- Nigeria, 2008—2009. MMWR , 2009 / 58(48);1345-1347
3. Nykonia Preacely , Oladayo Biya , Saheed Gidado, Halima Ayanleke, Mohammed Kida, Moses Akhimien , Aisha Abubakar, Ibrahim Kurmi, Ikeoluwapo Ajayi, Patrick

Nguku, Henry Akpan ; Hospital – Based Mortality in Federal Capital Territory Hospitals . 2005 – 2008. Pan African Medical Journal 11, 66, 11/04/2012

4. Aworh, M.K., Nwosuh C., Ajumobi, O.O., Okewole, P.A., Okolocha, E.C., Akanbi B.O., Nguku P. ; A Retrospective study of rabies cases reported at Vom Christian Hospital, Plateau State, Nigeria, 2006 – 2010. Nigerian Veterinary Journal 32 Vol 4
5. Pius Stephen Ekong, Raymond Juryit , Ndahi Mwapu Dika , Patrick Nguku, Monica Musenero ; Prevalence and risk factors for zoonotic helminth infection among humans and animals – Jos , Nigeria 2005 – 2009 . Pan African Medical Journal 12.6.12/05/2012
6. Sabitu K, Nguku P, Akpan H; Field Epidemiology Training in Nigeria: a novel approach to building sustainable epidemiological capacity to strengthen public health systems. Nigerian Journal of Epidemiology Vol.1 No.1 June 2011
7. Peter Nsubuga, Kenneth Johnson , Christopher Tetteh , Joseph Oundo , Andrew Weathers , James Vaughan , Suzanne Elbon , Mufuta Tshimanga , Faustine Ndugulile, Chima Ohuabunwo, Michele Evering-Watley, Fausta Mosha, Obinna Oleribe, Patrick Nguku, Lora Davis, Nykiconia Preacely, Richard Luce, Simon Antara, Hiari Imara, Yassa Ndjakani, Timothy Doyle, Yescenia Espinosa, Ditu Kazambu, Dieula Delissaint, John Ngulefac, Kariuki Njenga ; Field Epidemiology and Laboratory Training Programs in sub-Saharan Africa from 2004 to 2010: need, the process, and prospects. Pan African Medical Journal. 2011; 10:24
8. Carrie A. Dooyema, Antonio Neri, Yi-Chun Lo, James Durant, Paul I. Dargan, Todd Swarthout, Oladayo Biya, Saheed O. Gidado, Suleiman Haladu, Nasir Sani-Gwarzo, Patrick M. Nguku, Henry Akpan, Sa'ad Idris, Abdullahi M. Bashir, Mary Jean Brown ; Outbreak of fatal childhood lead poisoning related to artisanal gold mining in Northwestern Nigeria , 2010. Environmental Health Perspectives , Volume 120 / Number 4 / April 2012
9. Abubakar A, Sambo MN, Idris SH. Antenatal Care Services in a Rural Community in North Western Nigeria: The Wide Gap between Knowledge and Use of Maternal Health Services. Nigerian Journal of Maternal and Child Health 2009; 3 (1):32-39
10. Abubakar AA, Idris SH, Sabitu K, Shehu AU,Sambo MN. Emergency preparedness & the capability to identify

outbreaks: A case study of Sabon Gari Local Government Area, Kaduna state. *Annals of Nigerian Medicine January-June 2011; 4(1):21-27*

CDC Global Director's Visit
12th – 15th June 2010





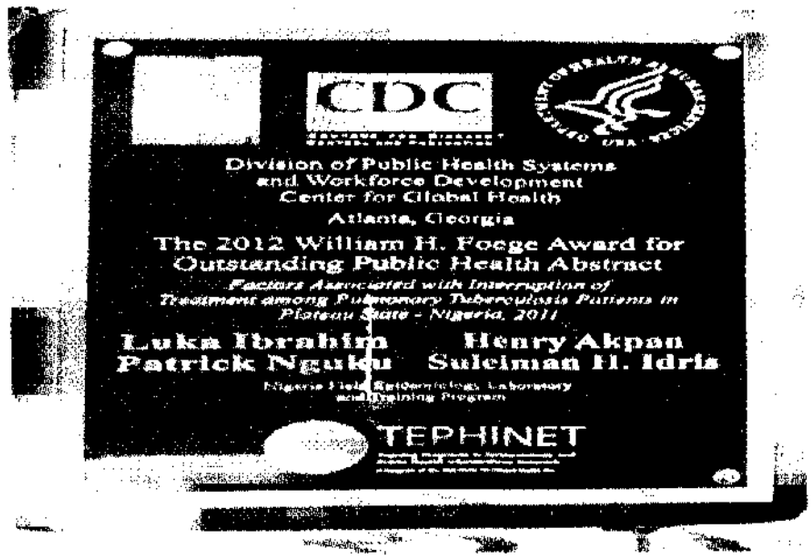

Where else can FELTP take you?



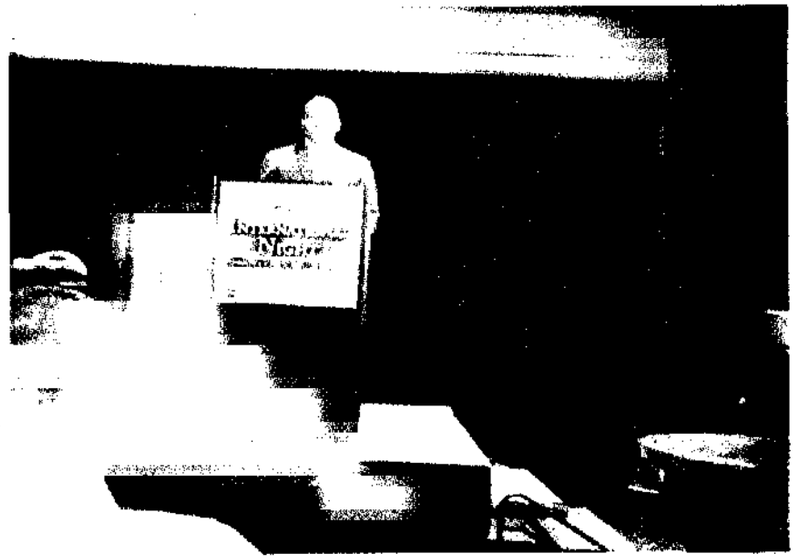

Cultural Night



AFENET
Conference Mombasa, Kenya Sept 2009



- **Dr Luka Ibrahim first resident from Africa to win the prestigious William Foege Award 61st EIS Conference USA 18th April 2012**



(f) **Nigerian Centre for Disease Control**

This was established in 2010 with help of US CDC with Professor Abdusalami Nasidi M.D, Ph. D, OON as its founding Director. It usually co-ordinate the various health responses and intervention activities in the country. It also has the responsibilities to prevent and control health emergencies and outbreaks. The NFELTP has since been incorporated in this NCDC.

13. CHALLENGES AND PROSPECTS

1. Getting a critical mass so as to reach all states and LGAs in the country as well as the Federal level.
   Maintaining quality of the training despite the grossing number of residents. Getting adequate number of mentors and supervisors to be attached to each and every resident is a big challenge at present.

Developing a Carcer pathway for the graduate of the NFELTP is also a very big challenge at present. Getting then

deployed back to their working positions and retaining them is also a big challenge.

3. Security Challenges particularly in the Northern Eastern Nigerian has made the recruitment and posting of NFELTP residents to the area a bit more difficult.
4. Funding and sustainability of the programme has been done mainly by donors especially the United States Centre for Disease Control (CDC) with some minimal funding from the Nigerian Government with the present global economic crisis most donors, have been reducing their funding, without the commensurate increases from the home government. This could be a great challenge to the sustenance of the programme in the country.
5. Long Strike Activities by members of the Academic Staff Union of the Universities (ASUU) leading to long delays in academic activities have been a great challenge to the continuous academic activities that this noble programme requires.

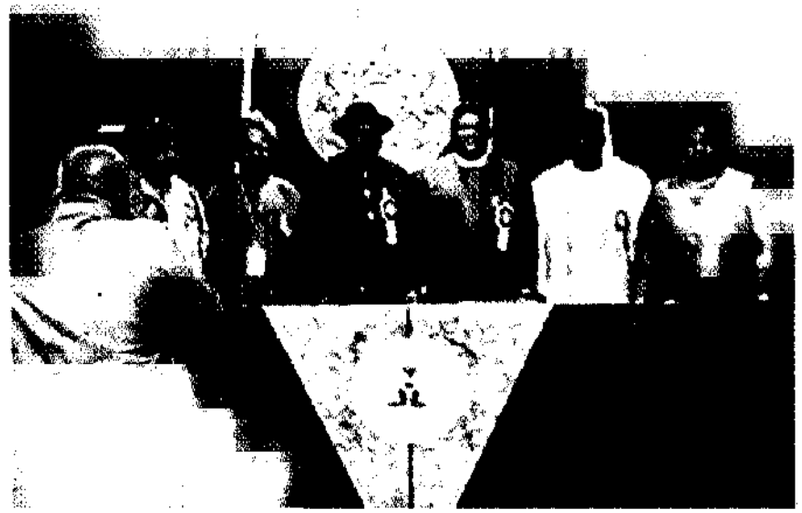
LESSON LEARNT

(1.) Partnership is critical for success.
(2.) Funding required – broad base
(3.) Clear planning is important.
(4.) Government leadership.
(5.) Networking is critical for success.
(6.) Career pathway, retention.
(7.) NELTP programmes should be aligned to national priority areas.

Mr. Vice Chancellor sir, please permit me before the conclusion of this presentation to present another story with the slides below. This story is a happy ending one. The three pictures are showing certification of Nigeria to be guinea worm free country. One of our resident of the program who is the Director of the Guinea worm eradication program in the FMOH is seen here accompanying the Minister of Health to receive the certificate from the President and Commander in Chief of the Federal Republic of Nigeria Mr Goodluck Ebelle Jonathan

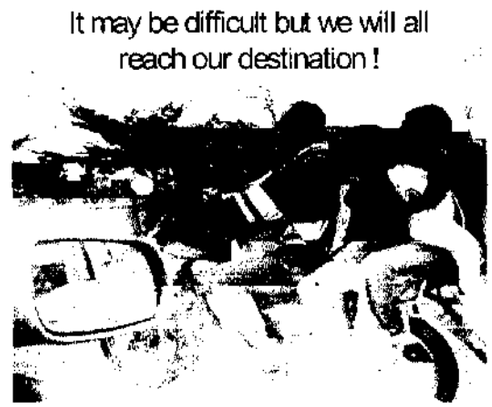






12. CONCLUSION

The NFELTP programme has strengthened the public Health System in Nigeria through competency –based training and service provision. Some of the areas strengthened are the workforce, the systems, institutions as well as the culture of change that is induced. NTELTP programme has now become institutional and we are getting off the old ways.



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Chapter Five

Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?

Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?

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Wednesday, 30th April, 2014



Mrs Helen Ochuko Kwanashie
Professor of Pharmacology

Dedication

To My Father and My Mother
Gray Augustine Akpobi, and
Jane Eseoghene Akpobi:
Who being used of God
Tirelessly bore me up.
In recalling exiles
They did much more than speak
For this woman, their child.

Acknowledgements

By way of acknowledgements, I had attempted a list of all who had played any positive role in my academic pursuit and career development, and was amazed that at the time I decided to abandon the list (which included institutions, teachers, supervisors, colleagues, students, family, friends, individuals and groups, etc), it had run into several pages! Though not in print here, each one of them is highly appreciated. *Still, I must mention some.*

First and foremost, I wish to thank the Vice-chancellor and other principal officers of ABU, Chairman and members of the University Organised Lectures Committee, Ahmadu Bello University Press, Public Affairs Directorate; and all others who have contributed in one way or the other to the actualization of this lecture. Secondly, my heartfelt appreciation goes to each and every one of you who make up this audience; for your kind attention. I must admit that in today's *still largely men's world*, it requires large doses of patience and tolerance to sit through, and listen to one hour of mainstreaming women and children's issues into pharmacology teaching, research, community service and their applications - for which reason, I thank you *most profusely!*

I am immensely grateful to my supervisors at various levels:

- BSc - Prof Godwin Emerole and Prof Michael Fafunso
- MSc - Prof Godwin Emerole, Prof (Mrs) M. Ira Thabrew and Prof B.O. Osinusi
- PhD - Prof Charles Wambebe, Prof Gabriel Osuide and Prof Christopher Ikediobi
- Postdoc - Prof Brian Burchell.

Prof Emerole's enthusiasm for biochemistry was infectious, resulting in my developing a sustained preference for science, over and above medicine. Prof Wambebe was instrumental to my conversion from biochemistry to pharmacology, of which finally, I am very glad!

It is also my honour to pay respect to my fathers and mothers in pharmacology (in addition to Prof Osuide), in the persons of:

- Prof Lateef Salako

- Prof Abdul Fattah Biola Mabadeje
- Prof David Okpako
- Prof Hope Obianwu
- Prof (Mrs) Lotte Lege-Oguntoye, and
- Prof (Mrs) Janet Makinde.

The greater part of the contributions I have made on the subject of pharmacology (especially as presented in this lecture), was the outcome of active collaboration with my teachers, colleagues and students; and with the highly valued technical support of other (non-academic) colleagues. Many of them are actually reflected in the cited publications we co-authored; all are hereby acknowledged particularly the following:

- Dr Janet Ejiofor who did some of the artemether and siculine studies,
- Dr Temidayo Olurishe and Dr Sherifat Anafi who investigated the co-administration of antimalarial and antiretroviral drugs.

Special thanks are due to my husband, Prof Mike Kwanashie, our children (plus their spouses) and our adorable grandchildren. The *enabling space* Mike gave me to achieve was phenomenal, and I owe much of my personal success to that. I first met him in 1972, and although it's 40 odd years since then, Mike's still very much *my guy!*

I am most pleased and highly honoured to pay a special tribute to two very loving and highly supportive persons; in appreciation of their faith in me, and the seed they planted and nurtured in my life. This inaugural lecture is dedicated to them. I cannot think of anyone more deserving of the honour than these two, my parents: *Late* Mr Gray Augustine Akpobi (1926-2008) and *Late* Mrs Jane Eseoghene Akpobi (nee Oguma, 1937-1979). I dedicate this lecture to them because in addition to several other inputs into my life; together, they recalled me from a multifarious exile! The choice of cimetidine (the antiulcer drug, Tagamet®) as the drug subject of my PhD research, is itself, a tribute to my father who suffered severely from duodenal ulcer before the discovery of cimetidine, other H_2 receptor antagonists (and newer antiulcer drugs), as well as the definite implication of *Helicobacter pylori* in the aetiology of peptic ulcer disease. (I should add that he benefitted

greatly from using cimetidine). Similarly, my life-long interest in women issues may be attributable in part, to the times and experiences of my mother. It is an extremely deep sense of personal loss, pain and regret I feel, that neither of them is here today to witness my inaugural lecture presentation.

Last to be acknowledged herewith, but certainly not the least, my deepest, most profound gratitude of all goes to the triune God - Father, Son and Holy Spirit, who more than everyone else, worked with me... Indeed, like Isaiah 26:12 proclaimed, God has established peace for me all round, *and all that I have accomplished, He has done for me!*

While the pharmacological basis of this inaugural lecture had previously been expounded upon, the theme was inspired primarily, by some texts taken from The Holy Bible. The first two of these texts (one from each of the Testaments) make the point that God, the creator of the entire universe and all that is in it (including human beings), intended for men and women to be equal partners (albeit with different roles). I quote these key texts as follows:

> So God created man in his own image, in the image of God he created him; male and female he created them... He created them male and female and blessed them. And when they were created, he called them 'man.'
>
> *- Genesis 1:27,5:2, NIV.*

> *Submit to one another out of reverence for Christ.* Wives, submit to your husbands as to the Lord. For the husband is the head of the wife as Christ is the head of the church, his body, of which he is the Savior. Now as the church submits to Christ, so also wives should submit to their husbands in everything. Husbands, love your wives, just as Christ loved the church and gave himself up for her to make her holy, cleansing her by the washing with water through the word, and to present her to himself as a radiant church, without stain or wrinkle or any other blemish, but holy and blameless.
>
> *- Ephesians 5:21-27, NIV. (italicised emphasis, mine).*

The third inspirational text reports on God's constant desire to recall exiled persons, as exemplified by King David's dealings

relating to his recalcitrant son, Absalom - a figure of God's dealings with us. The text, and my exposition on it, read:

> The King's heart longs for us in exile (separated on account of wrong doing) … Who does not take away life; but devises ways so that a banished person may not remain estranged from Him.
> - *2 Samuel 13:39-14:1,14b. (paraphrased by me).*

And the King so loved
He gave *Him*:
Whose blood speaks
Far more eloquently
Than that of Abel…
And as many as would believe
Shall be eternally
Recalled from exile!
- © HelenOK, 2010.

Mr Vice-chancellor Sir, Ladies and Gentlemen, once again, I thank you for your attention. God bless!

Summary

This inaugural lecture is presented in four integrated parts (equivalent to chapters), with Part I being an introduction that sets the stage. Part II highlights the plight of women of child-bearing age, pregnant women, women in labour, breastfeeding mothers, and children below the age of 12, as *therapeutic exiles* since they are theoretically banished from using most drugs due to paucity of laboratory and clinical data (rather than damaging data). Nonetheless, since their disease conditions are treated with these same drugs, women and children are automatically the targets of *therapeutic smuggling*, which worsens their sorry state in exile. It is shown that the outcome of therapeutic smuggling is that women and children are frequently uninformed participants in unplanned, uncontrolled, usually unreported experimental drug usage! The lecturer posits that the needs and rights of women and children to effective and safe drugs are no less than those of the rest of the population, and that the time is overdue for recalling women and children from therapeutic exile through research and documentation, as a prelude to ending the dangerous practice of therapeutic smuggling. Part III outlines some modest contributions made by the lecturer (together with her colleagues and students) over thirty odd years of research (mostly in Ahmadu Bello University), towards recalling women and children from therapeutic exile. In these her ethically-sensitive research, the interfacing interests are disease conditions that are prevalent in the tropics and developing world, and to which women and / or children are particularly susceptible directly and indirectly - such as malaria, HIV/AIDS and sickle cell disorder. These *in vitro* and *in vivo* research are mainly into drug effects in animals, but include also, some non-animal based research - such as tissue culture and 'human studies' which have more direct clinical applications. The lecturer also reports routine mainstreaming of these philosophies, principles and practices into her teaching, student supervision-cum-guidance, professional discourse and community service. In Part IV, using several examples to buttress the point, the lecturer hypothesizes that therapeutic exiling and smuggling are just extensions of the gender discrimination against females in other spheres of life, and the somewhat lesser

discrimination against children. Noting that the millennium development goals are not just about human development in general, but more about women and children (the girl-child in particular), the lecturer believes that the need to recall them from exile has become a universal, and perhaps even legal project. Triangulating the three main parts, she puts forward a clarion wake-up call for all to actively engage in the proposed recalling of therapeutic exiles by challenging them with some identified roles for biomedical researchers and others alike. Thus, drawing on the outcome of her research efforts and experiences some of which are highlighted in this lecture, and in the light of her future goals, the lecturer champions the cause of *recalling women and children from therapeutic and indeed other exiles*, in one small voice.

Chapter One

Introduction

1.1 Protocol

The Vice-chancellor, Prof Abdullahi Mustapha - also Member, Faculty of Pharmaceutical Sciences
The Deputy Vice-chancellor (Administration), Prof Ibrahim N. Sada
The Deputy Vice-chancellor (Academic), Prof Ali Adamu
The Acting Registrar, Mal Ahmed Abdullahi Kundila
The Bursar, Mal Ibrahim Shehu Usman
The Acting University Librarian, Dr Kosoko O. Momoh
Dean, School of Postgraduate Studies, Prof Joshua Adebayo
Prof B.B.M. Dewu - Chairman, University Organised Lectures Committee; and other Members of the Committee
Prof Mike Kwanashie (Vice-chancellor, Veritas University, Abuja)
Prof Ibrahim Abdu-Aguye (Professor of Pharmacology), and other Professors of ABU extraction
Prof Godwin Emerole (Retired Professor from University of Ibadan), and other Professors from elsewhere
Dr Umar Usman Pateh - Dean, Faculty of Pharmaceutical Sciences; and other Deans and Directors
Dr Abdulkadir Umar Zezi - Head, Department of Pharmacology and Therapeutics; and other Heads of Departments
Members, University Senate
Distinguished Colleagues
Highly Esteemed Students
Invited Guests
Ladies and Gentlemen:

1.2 Preamble

I wish to begin this lecture by making reference to the vision statement of this great university - Ahmadu Bello University (ABU), Zaria, Kaduna State, Nigeria; hereby rendered.

> Ahmadu Bello University shall be a world-class university comparable to any other, engaged in imparting contemporary knowledge, using high quality facilities and multi-disciplinary

> approaches, to *men and women* of all races, as well as generating new ideas and intellectual practices relevant to the needs of its immediate community, Nigeria and the world at large.
>
> *- ABU's Vision from 2012 to date (italicised emphasis, mine).*

As an aspirational description of what ABU will like to accomplish, it may be viewed as an improvement on the vision at the university's inception in some respects, such as: being of *world-class standard*, imparting *contemporary knowledge*, intended use of *high quality facilities* and *multi-disciplinary approaches*. That notwithstanding, the original vision statement remains one of my favourite quotes, and is hereby rendered.

> The cardinal principle upon which our University is founded is to impart knowledge and learning to *men and women* of all races without any distinction on the grounds of race, religious or political beliefs.
>
> *- Sir Ahmadu Bello[60], in Our Charter, 23rd November 1963 (italicised emphasis, mine).*

These keywords namely: *men and women* are by no means restricted to our vision here in ABU; similar sentiments having been expressed in the vision statements of many other universities from within Nigeria (e.g. Benson Idahosa University), in Africa (e.g. University of Swaziland in South Africa) and outside the continent (e.g. Tufts University in the United States). Indeed, some universities and other establishments (e.g. Tufts University and the United Nations in some of its renditions), speak of *women and men* rather than of *men and women*.

Ladies and Gentlemen, against this background, I must proceed with the fact that like the current vision statement (and many others from all over the world), ABU's honourable first chancellor, deliberately spoke of *men and women* in one and the same breath, conveying the belief that men and women are to be joint and equal beneficiaries of the lofty ideas in his proclamation - so akin to the thesis I am about to propound! Because we share

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[60] Sir Ahmadu Bello, (KBE, MHA), Sardauna of Sokoto and Premier of defunct Northern Region of Nigeria, after whom the University was named, was First Chancellor of ABU.

these same ideals, I dare say that were Sir Ahmadu Bello to be alive today, and a professor of pharmacology in this blessed university, perhaps, he could be the one delivering this inaugural lecture; which for me, increases the privilege and pride I feel, to be engaged in this very exercise.

This is the first inaugural lecture from ABU's Department of Pharmacology and Therapeutics (erstwhile Department of Pharmacology and Clinical Pharmacy until 2009). It is the third in the Faculty of Pharmaceutical Sciences, which as Department of Pharmacy and Pharmacology, came into being in 1968[61]. The earlier two inaugural lectures from the Faculty were given by Late Prof Musa Shok of the Department of Pharmacognosy and Drug Development (and once our Deputy Vice-chancellor), in 1999; and Prof Josiah Onaolapo of the Department of Pharmaceutics and Pharmaceutical Microbiology in 2008.

1.3 Anecdote about a 'Mummy-General'

Permit me, Ladies and Gentlemen, to narrate a small and personal anecdote about a 'Mummy-General': Today, many (particularly students), in the Faculty of Pharmaceutical Sciences where I had been teaching since 1982, refer to, and address me as 'Mummy', rather than the more professional 'Prof(essor)' or even more formal 'Madam'. I suppose reference to me as 'Mummy', has to do in part, with biological age; and partly with 'service longevity' - having taught many lecturers (some of whom are professors themselves), in this same Faculty[62]. But things were not always so; and yes, I did have a less desirable nickname.

Towards the end of the last decade of the last millennium, much to my chagrin, I stumbled upon the fact that students in the Faculty had nicknamed me 'General'. My distress should be understandable because at the time of this chance finding, within the context of the social, economic and political history of our country,

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[61] This was under the headship of Prof Gabriel Osuide; with first student admissions in 1970, these graduating with BSc Pharmacy in 1973. Transition from Department to Faculty (again under the headship of Prof Osuide as founding dean), occurred in 1982 which has since then, trained students to be awarded Bachelor of Pharmacy (BPharm) degrees by the University.

[62] Other old students of mine are professors outside the Faculty and outside this University.

in addition to various other reasons, no regular person wanted to be associated with the military, let alone its top echelon - symbols, jokes and nicknames inclusive! Not even the explanation that I had genuinely earned the nickname which had its origin in the fast, no-nonsense, firm (even tough), organized, strategic and precise nature of my character and dealings with students and staff, in and outside of the classroom, was much comfort. Nor were the assurances that the nickname had been given, used and meant to be a *compliment* to me! I do not know for how long the nickname had been in existence before I became aware of it; and I must confess that as at today, I do not know if it is still applied to me. All of these notwithstanding, my ultimate response to this nickname, was to draw on a general principle I tend to apply in my life, which is: to graciously, positively and wholeheartedly accept and work with(in) situations and circumstances that I cannot change, regardless of my initial feelings. On several occasions, I had even gone beyond this acceptance level, to celebrate such circumstances - a situation example being my transformation from angling for the pursuit of a seemingly exotic medical training-cum-profession into what I have come to embrace and hail as the truly exciting world of experimental science! It is on this note, Ladies and Gentlemen, going by the verdicts of highly important stakeholders in my career (being my students), that I see myself as a *Pharmacology 'Mummy-General'*, who is privileged to share some thoughts with you today regarding women and children as therapeutic exiles to whom most drugs are first denied, then smuggled; and in so doing, attempt to champion the worthy cause of challenging many to redress their plight. Accordingly, I have titled my lecture: *Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?*

1.4 Pharmacology, Pharmacy and Therapeutics

Considering that this audience is made up of individuals from highly diverse backgrounds stretching from the pure or liberal arts through pharmacology and other biomedical sciences, to nuclear energy and politics, etc, in order for us all to start off on the same page, I feel it is expedient for me to explain what Pharmacology is (and what it is not), since this is the first inaugural lecture from Pharmacology, and the discipline is frequently confused with allied disciplines, especially Pharmacy.

The Department of Pharmacology and Therapeutics here in ABU, is situated in the Faculty of Pharmaceutical Sciences[63] which is made up of four additional departments, namely:

- Department of Pharmacognosy and Drug Development
- Department of Pharmaceutics and Pharmaceutical Microbiology
- Department of Pharmaceutical and Medicinal Chemistry
- Department of Clinical Pharmacy and Pharmacy Practice.

This set up is similar to what obtains outside ABU - elsewhere in Nigeria, and in several institutions abroad. Although there are various MSc and PhD programmes available in the Faculty, at undergraduate level, only one degree, namely: BPharm[64], is currently offered and awarded. Holders of BPharm degrees are eligible to be registered/licensed as pharmacists to practice pharmacy which is a profession concerned with the safe and effective use of medicinal substances, appropriately sometimes termed: *pharmaceuticals*. Table 1 provides the meaning of pharmacology, its beginnings and aims, and the meaning of therapeutics - both essential concepts to understanding this lecture.

[63] The Department of Pharmacology and Therapeutics is also a clinical science department in the Faculty of Medicine where Pharmacology is required for training of medical and nursing students, as well as for accreditations by the National University Commission, Medical & Dental Council of Nigeria and Nursing & Midwifery Council of Nigeria.

[64] The BPharm degree may have a Doctor of Pharmacy (Pharm D) degree added to it, or replacing it, in future.

Table 1: Pharmacology, Pharmacologists and Therapeutics

Terminology / Concept	**Meaning**
Pharmacology, its Beginnings and Pharmacologists	Derived from the Greek words *pharmakon* meaning 'drug' and *logia* meaning 'study', Pharmacology (one of several science subjects taught to medical, pharmacy, nursing, veterinary and allied students), may be defined as the study of drugs, their sources, nature and properties, as well as all aspects of their interaction(s) with living organisms. Before the 19th century, pharmacology focused on natural substances, mainly plants (modern day Pharmacognosy), but has since developed into a biomedical science that apply the principles of scientific experimentation to therapeutic contexts. It replaced the old *Materia Medica* which had described drugs and their effects without bothering on mechanisms of action. The subject can be sub-divided into Basic Pharmacology and Clinical Pharmacology. Thus by background, pharmacologists could be scientists (of which the lecturer is one), medical doctors, pharmacists and veterinarians, etc.
Aims of Pharmacology	Pharmacology has two prinicipal aims: • to understand the interaction of life with its chemical surroundings in terms of cause and effect; and • to promote health by, and prevent toxicity from, chemicals by means of such understanding. Pharmacology shares its goal / aims with its sister disciplines - Physiology and Pathology - which studies life under normal and abnormal conditions respectively.
Therapeutic	Derived from the word 'therapy', therapeutic refers to the treatment of disease conditions.

Thus, pharmacology forms the basis for therapeutics, and it explains how the subject matter of this lecture *Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?* deals with potential / actual uses and consequences of drugs, and the significance of the effects they produce, when administered in pregnancy, during delivery or breastfeeding, as well as in early childhood; regardless of the disease conditions of use.

I should add that by my background, I am neither a *pharmacist* pharmacologist, a *medical doctor* pharmacologist nor a *veterinarian* pharmacologist, etc; but rather, that I am a *biochemical* pharmacologist!

1.5 Aim and Objectives

The overall aim of this lecture is to demonstrate that the seemingly rhetorical question *Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?* is a timely and answerable one in practical terms. To achieve this aim, four specific objectives will be addressed, as follows:

i. To set the stage for the discourse via an introduction.

ii. To define *therapeutic exiles* and *therapeutic smuggling* and explain their significance.

iii. To highlight some of the lecturer's contributions over a period of thirty odd years, in recalling therapeutic exiles and redressing this sorry situation of women and children.

iv. To conclude that therapeutic exiling is an extension of the more pervasive gender (and sometimes child) discrimination in society, and that everyone has a role to play in recalling therapeutic and other exiles.

Chapter Two

Therapeutic Exiles and Therapeutic Smuggling[65]

2.1 'Therapeutic Exiles'

2.1.1 Who Are Therapeutic Exiles?

The perinatal period which refers to that period of life just before, during and shortly after birth (Stern, 1975), is very often neglected in studies involving drug use because of possible adverse effects especially to the baby at this critical stage of its development. Obviously, such caution is needful and well meant. Nevertheless, the restraint is carried too far, with the result that in virtually all aspects of drug investigations, the perinatal period is nearly always excluded (Shirkey, 1968a, 1999 and Wilson, 1975). Consequently, pregnant women, women in labour, breastfeeding women and young children are often excluded from many useful drugs, since usually little or no data is available on either the pharmacodynamics or pharmacokinetics of such drugs when given to these subjects. It was in recognition of the limited availability of drugs for children, that Shirkey (1968a) coined the expression "*therapeutic or pharmaceutical orphans*".

In view of the prevalent exclusion of perinatal subjects in general from useful drugs, the term '*therapeutic exiles*', coined by the lecturer and used for the first time in her PhD dissertation (Kwanashie, 1990), may aptly be employed to describe pregnant, obstetric and breastfeeding patients in addition to Shirkey's paediatric 'orphans'.

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[65] Most of this Chapter is culled from Chapter One of the lecturer's PhD dissertation (Kwanashie, 1990). It is informative that in the nearly 25 years since then, therapeutic exiling and therapeutic smuggling has not changed significantly.

2.1.2 Background to the Exiling Process

Therapeutic exiling dates from the late 1930s (Shirkey, 1968a). However, the most significant landmark in that history, is the celebrated limb and other congenital malformations that accompanied the use of thalidomide in the late 1950s and early 1960s (Lenz, 1962). The thalidomide incidence underscored the point that the placenta is not an absolute barrier (Flowers, 1959 and Howe *et. al., 1*981) and maternally administered drugs may have detrimental effects on the foetus particularly if administered at the critical stages of organogenesis. This obviously dictates that drugs be cautiously used in all women of child bearing age who are sexually active, which has since formed the basis for the banishment of a large proportion of women from many drugs.

Furthermore, when barbiturates were administered to the mother during labour, the newborn's respiration was depressed indicating that the drug was transported via the placenta to the baby before birth (Villee, 1965). Clearly, cautious use of drugs during labour is advocated, a restraint that has been overtly exaggerated leading to the obstetric patient being therapeutically exiled.

Besides transplacental routes, maternally administered drugs may reach the newborn via breast milk (Anderson, 1977 and Wilson *et. al., 1*980). The excretion of drugs in milk means of course that the breastfed infant is of necessity exposed to drugs taken in by the mother. It is for this reason that breastfeeding women are also frequently exiled.

It is known that drug effects in adult and the young are sometimes different (Atlas *et. al.*, 1977, and Szorady *et. al., 1*987). For example, many hepatic microsomal isozymes and renal excretion mechanisms of the newborn are not fully developed until the age of two or much more. Consequently, the very young child is usually more susceptible to drug effects than the adult. It is therefore necessary to exercise restraint in the use of drugs in infants. In practice however, such restraint has led also to the exiling of children from the therapeutic domain.

2.2 'Therapeutic Smuggling'

2.2.1 Disclaimer Notices and Therapeutic Smuggling

What amounts to disclaimer notices are very often inserted in drug packages or manufacturers' prescribing information sheets. Some of the frequently encountered warnings read thus:

Not to be used in pregnancy
Avoid use while breastfeeding
Its use in children has not been evaluated.

It should be noted that this does not apply to orthodox drugs alone, especially as there is a growing interest in herbal remedies and other dietary supplements which stemmed from the shortcomings of conventional medicines, the beneficial effects reportedly derived from the traditional medicines, and society's erroneous view of herbal medicines as being always safe just because they are 'natural'. Indeed, the Paxherbal bitters – a herbal health tonic from Ewu, Edo State, carried the following disclaimer and caution.

These claims have not been evaluated by NAFDAC.

The safety of use of Pax Bitters during pregnancy has not been evaluated. Physicians' advice is required before use during the first trimester of pregnancy.

The situation is similar for other complementary and alternative medicines regardless of their country of origin, as was observed for Kasapreko (Alomo bitters from Accra, Ghana) and EDMARK Shake Off (Phytofiber from Malaysia). In accordance with the tenets of the disclaimer notices, perinatal subjects would be excluded from most drugs. The reality of the situation however is that these subjects, that is, pregnant or lactating women and young children are not immune to diseases for which drug therapy is required. In practice, they do in fact need and receive drugs prescribed, or by self medication in spite of whatever body of words are inserted in leaflets by manufacturers (Wilson, 1975). Such practices amount to smuggling of materials (in this case drugs) to

those in exile! *And smuggling is always a dangerous exercise, perhaps more so, on this arena.*

Even a cursory look at the rather fashionable disclaimer notices reveal that the warnings exiling women and children are seldom absolute in their phrasing. The disclaimers often present the physician or potential drug user with one or two clauses such as:

> The physicians should weigh risks against benefits.
>
> The physician should use his judgement.

The onus of decision is therefore left with the physician or patient who is often unaware of the exact risks he is told to weigh. In fact, usually, neither the manufacturers nor other independent researchers know exactly what these risks are, the reasons being the lack of data concerning drug effects in the perinatal period. The situation is therefore such that there is often nothing actually on the "risk pan" of the balance against which to weigh drug benefits. Generally, what the physicians or patient usually know are possible benefits, to the exiled patient, based of course on data collected from subjects outside this category. It is understandable therefore, that where he is encouraged to use his judgment or weigh unknown risks against known benefits, the physician is likely to go along with the therapy in spite of the disclaimers and their clauses (Shirkey, 1968a and Wilson, 1975). It had been shown that where disclaimers were due to lack of data rather than damaging data, physicians considered them mere opinions or legally motivated-statements and ignored them (Wilson, 1975). As a result, the child bearing woman and her baby are frequently uninformed participants in unplanned, uncontrolled, usually unreported experimental drug usage[66]. This situation of drug smuggling or *therapeutic smuggling* to *therapeutic exiles* is more precarious and fraught with danger when compared to that in which planned, controlled and published studies are preliminarily carried out in animals, before being cautiously and appropriately extended to humans.

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[66] The controversial clinical trial of Pfizer's new (at the time), untested and unproven antibiotic, Trovalfloxacin (Trovan) against *Meningococcal meningitis* in paediatric patients Kano, Nigeria, is a case in point.

In the biomedical literature, there is mammoth evidence for this dearth of information from the premises of both drugs and diseases. For example, analysis of the available information for over 500 commonly used drugs carried out by the lecturer in the 1990s, had shown that for half to two thirds, there was little or no information regarding their use during pregnancy and breastfeeding (Kwanashie, 1999). Treatment of malaria (a disease of high morbidity and mortality in many parts of the world), with old and new drugs, against sensitive and multi-drug resistant forms of the causative *Plasmodia* parasite, also portrays the limited availability of safe and effective medicines for the highly vulnerable populations of women and children; as is the situation for most other disease conditions including HIV/AIDS. More recently, we showed that 94.09% of 59 generics/brands of antimalarials had no information regarding their safe use in women and children (Kwanashie *et. al.*, 2011). Non-availability of information in women was of the following magnitudes: pregnancy (91.93%) and lactation (88.54%). In contrast, adequate prescribing information for use in children, was available for 80% of the antimalarials studied. However, even when information was available, the antimalarials may still not be used in lactation (11.46%), pregnancy (7.42%) and children (0.56%) as a result of cautions due to lack of data, rather than damaging data. Thus, the gross inadequacy of information available for rational prescribing and dispensing of antimalarials in women and children remains unchanged.

2.3 The Foetus: A Patient in His Own Right

So far, this issue of drug use in the perinatal period has been examined solely from the point of view of toxicity. However the use of drugs in the perinatal period need not be seen only in terms of adverse effects to child and/or mother. While it is easy to appreciate direct advantages of drug therapy to mothers and children, benefits to foetus may not be so obvious. Yet successful diagnosis and management of erythroblastosis foetalis by transfusions *in utero* (Liley, 1963) had infact propelled the foetus into a legitimate exalted status as a patient in his own right. It is now known that maternally administered drugs may cause beneficial, and not always detrimental effects in the foetus. For example, antibiotic treatment of maternal

syphilis in pregnancy, resulted in the cure of foetal infection which was of even greater consequence than the maternal disease itself (Yaffe and Stern, 1976). Secondly, administration of phenobarbitone to the mother for two weeks prior to delivery had been used to treat foetuses sensitized with haemolytic disease by causing foetal microsomal enzyme induction and subsequent metabolism of the excessive bilirubin (Yaffe and Stern, 1976). Other intrauterine foetal diseases have been demonstrated e.g. acid peptic disease (Lee and Wells, 1923) which may respond equally well to drug therapy *in utero*. Studies on drug use in the perinatal period may therefore unearth therapeutic advantages to the unborn as well as the born child and his mother.

2.4 Recalling 'Therapeutic Exiles'

2.4.1 Animal Studies

While appreciating the ethical grounds for restraints in pharmacological research in the perinatal period in humans, there is no reason why such studies should not be carried out in animals. Of course, there will be problems of species differences and extrapolation of data obtained from such studies to man. However, such difficulties would not be exclusive to studies on effects of drugs in the perinatal period. Indeed they apply equally well in other periods of life. And if in spite of such difficulties, reasonable extrapolations are made, there is no reason why the same should not be possible in the perinatal period. It is pertinent at this juncture to remark that the thalidomide disaster which provided a major impetus for the exiling of perinatal subjects, could have been averted if pre-market animal studies had been extensive since such studies later conducted, showed the same limb defects in animals as observed in man (Bignami *et. al., 1962*). Emphasis therefore must be placed on extensive and multidisciplinary studies, in several species of animals besides the rodents, and including wherever possible non-human primates such as the monkey since the latter generally provide more relevant data to man than lower species of animals (Wong, 1972 and Dvorchick *et. al.*, 1974). Following such extensive animal studies, positive aspects can then be followed up in man. It is unlikely that the risk factor in such cases, will be any greater than in studies involving other periods of life.

2.4.2 Human Studies

In fact, some experiments may actually be carried out on human tissues which will not prove detrimental to mother and child. For example, *in vitro* isolated transplacental perfusion techniques may be employed to study placental transport and metabolism of drugs and so provide relevant information concerning drug effects *in utero* (Dancis, 1974). Secondly, isolated human uterine myometrial strips (obtainable as trimmings during Caesarean sections or hysterectomies), may be used in *in vitro* research to provide valuable data regarding the effects of drugs on uterine contractility and relaxation; with appropriate clinical significance/application in abortion and labour. Thirdly, drug excretion in breast milk can be easily studied in a mother whose baby is being artificially fed for other reasons. These are some examples of safe yet valuable studies that can be carried out in human subjects during the perinatal period. Although such studies are being carried out, they are neither comprehensive nor extensive and much can be achieved if they are made more routine. More conclusive human studies may in fact be contemplated and executed following positively indicated results from such preliminary studies. The current practice of smuggling drugs to perinatal subjects in exile, as previously asserted, is perhaps more dangerous than the human studies so recommended. Recently in 2013, the UK National Centre for Replacement, Refinement and Reduction of Animals in Research (NC3Rs) and the Medicines and Healthcare products Regulatory Authority (MHRA) convened an expert working group on the use of human tissue in testing the safety of potential new medicines, with an initial focus on safety pharmacology studies.

Evaluation of human epidemiological data will definitely also provide additional understanding about drug effects in the perinatal period. A major problem with this however, is that under-reporting is usually high, especially as some of the drug usage is 'illegal'. Needless-to-say, prospective epidemiologic studies must involve drugs which not only would have passed severe animal studies, but which are also essential drugs with regards to the disease conditions and particular patient groups.

2.4.3 *In Vitro* Studies

The continuing debate about animal rights and their use for experimental purposes has led to the development and use of cell lines and tissue culture techniques, to the extent that these have even more direct applications to humans.

2.4.4 Perinatal and Paediatric Pharmacology: Who Will Test the Drugs?

The current practice of evaluating drugs using only *male adult* animals and humans need to be reviewed. Their female counterparts and the young ones need attention too! Perinatal subjects need not remain *'therapeutic exiles'* to whom most drugs are first denied, then *'smuggled'*. Their needs and rights to effective yet safe drugs are no less than those of the rest of the population. This latter situation requiring extra caution where humans are involved, though formidable should not be intimidating. Drug toxicities in the newborn for example, that once seemed formidable such as those due to chloramphenicol, can now be avoided only because they are better understood.

In answering his own question, *Pediatric pharmacology: Who will test the drugs?*, Wilson (1972) identified roles for the scientist as well as the paediatric pharmacologist. Indeed as far back as nearly a half century ago, it had been recognized that 'therapeutic orphans is everybody's business' (Shirkey, 1968b, 1970, 2006). Sadly, other than a few desperate questions (Shirkey, 1970, Wilson, 1972 and Gazarian, 2003), not much has changed since Shirkey first blew the whistle on therapeutic orphans in 1968 (Collier, 1999, Stephenson, 2001 and Gazarian, 2003); although some positive changes are more recently being seen (Feng, 2012). Does this pose special challenges to the female biomedical scientist engaged in fundamental experimental pharmacology as well as allied professional women? Should it be the purview of their male counterparts as well? While a modest amount of additional information may not cause the disclaimer notices to be completely removed due to the ever-present liability stances, it will certainly lead to a re-wording of the clauses. At any rate, users of drugs in the perinatal period will certainly be

better informed, which ought to enhance rational use of drugs in the overall interest of women and children.

2.5 Art Exhibition

I have translated the aforementioned situation of women and children into an artwork which was displayed at the 3rd Exhibition of KINESIS Women Art and Science[67]. The theme of the exhibition which held in Abuja, from 26th November to 2nd December, 2001 was *Matter*[68]; and my exhibited poster makes the point that recalling women and children from therapeutic exiles is the crux of the *matter!*

The artwork shows a boat conveying a variety of drugs in diverse dosage forms (tablets, capsules, syrups and injectables) from the mainland (basically a man's world, including therapeutically) to women and children in their 'lonely island' where they had been banished from these drugs - Figure 1. Persons featured in the mainland represent the clinician who is implicated in the smuggling, and the scientist who together with the clinician can provide the requisite research data for rational drug use in women and children, making therapeutic smuggling unnecessary, and thereby recalling women and children from therapeutic exile. The expanded statement for the artwork is summarised in a short poem beneath the miniature version of the artwork, reproduced in this lecture.

In the original exhibited artwork, the words of the poem were strewn along, and across the body of water[69].

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[67] KINESIS is an association of women (led by Dr Adele Garkida of the Dept of Industrial Design), who research the interaction between art and science in their daily lives, and portray this in the form of art. KINESIS is affiliated to CATALYST, a similar organization based in the U.K.

[68] The themes of previous KINESIS exhibitions were: *Essence* (Kaduna, 1999) and *Essence* 2 (Zaria, 2000). A 4th exhibition was tagged *Molecular Construction* (Zaria, 2003), chosen to commemorate the 50th anniversary of the discovery of the genetic code, DNA; and for which this lecturer had written a poem celebrating women as hardworking goods producers, services providers and care givers - see Chapter Four.

[69] This artwork was assembled by the lecturer, a member of KINESIS, using a combination of several computer packages: Microsoft Word, Windows Draw and Instant Artist. Most of the components were imported directly from the clip art works in these packages (then

In light of the above, and in answer to this lecture's poser: *Recalling 'Therapeutic Exiles': Who Speaks for Women and Children?*, I have earnestly sought to be a voice for them throughout my career by making studies on effects of drugs in the perinatal period and in the very young, a priority area of my research. I shall now proceed to summarise what modest contributions I have been able to make in this regard through my research, teaching and community service.

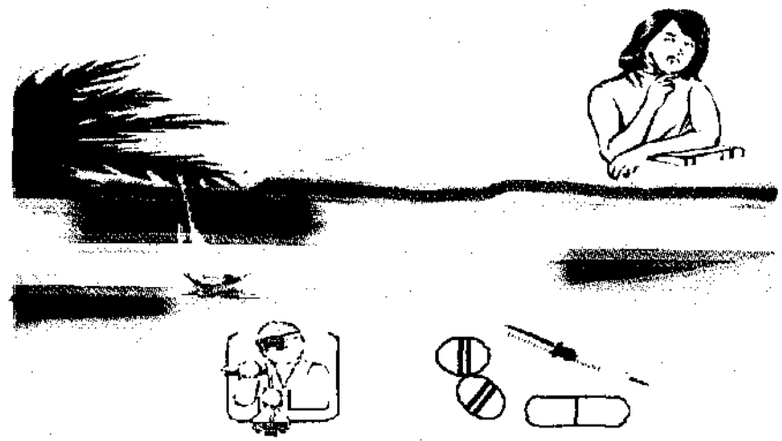


Figure 1: Therapeutic Exiles and Therapeutic Smuggling

Women and young children:
Therapeutic exiles
To whom most drugs are *first* denied
Then smuggled.
Who speaks for women
And children?
That is the crux of the matter!
- ©HelenOK, 2001

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manipulated); but a few (tablets and capsule) were created *de-novo* by the lecturer. Despite constraints imposed by the imported clip art pieces, the work itself is without respect to race, sex, and the like.

» HelenOK, derived from Helen Ochuko Kwanashie is the pen name of the lecturer in the literary arts. Kwanashie is keen on developing interphases between science and art with poetry and computer graphics as her principal modes of expression - See also Chapter Four.

Chapter Three

Recalling 'Therapeutic Exiles': Contributions by Lecturer

3.1 Presentation and Evaluation of Contributions

The approach I have chosen to utilize in summarising my contributions to recalling therapeutic exiles through research, teaching and community service, is ordered as follows.

i. Chronologically from my BSc to Post-doctoral research projects (Table 2)
ii. Other research carried out outside my education and training, especially those on antimalarial drugs, antiretroviral drugs, sickle cell disorder, etc, and including those of supervised students' research projects
iii. Contributions through teaching and community service.

Avoiding technicalities wherever possible, briefs on the objectives and key findings in each case will be presented. However, some details of representative research will be provided (e.g. research on cimetidine on isolated uterus, tissue culture and sickle cell disorder).

How do we evaluate a research, teaching and community service output to arrive at the conclusion that it has made a contribution to recalling women and children from therapeutic exile? The answer to the above pertinent question is that the output must meet one or more of the following criteria based on the definition / aims of pharmacology as previously described:

- lead to a better understanding of the physiology (normal situation) and/or pathology (abnormal situation) of the condition under investigation
- promote health
- prevent toxicity
- describe what the drug (medicine/chemical) does to the body, i.e. effects produced by the drug

- describe how the body responds to the drug (medicine/chemical), i.e. responses produced by the body
- make for rational drug use in women and children.

3.2 BSc Research on Food, The Ultimate Medicine

My first attempt to speak for women and children, and so contribute to recalling them from exile was in both of my BSc research projects, one of which dealt with detection of carcinogenic polycyclic aromatic hydrocarbons (PAHs) in Nigerian smoked fish, and which had possible toxicological consequences for women who usually carry out the food smoking (Akpobi, 1979a). The other project dealt with aspects of nutritional changes that take place when maize is processed to the popular Nigerian weaning food called *ogi*[71] (Akpobi, 1979b). After all, there are several facets for food-drug interactions, and food may easily be considered, the ultimate drug - dealing with toxins, inflammation, damaged tissue, suppressed immunity - to mention but a few (http://www.highstrangeness.tv/show_news.php?n=6027; Wolcott and Fahey, 2002; Bell, *et. al., 2014*)! Doesn't the absorption of both take place at the same primary site, being the first part of the small intestine? Don't the same factors such as physicochemical properties of the substance, nature of the biomembrane interphase, pH of the medium, small intestine residence time, etc, also govern the absorption of both? Aren't both food and drug subject to other similar pharmacokinetic processes of distribution via the blood, biotransformation in the liver, and excretion by the kidney? Etc, etc?

Indeed many foodstuffs, condiments and spices have long been recognised as medicinal e.g. pawpaw, garlic, ginger, bitter kola, bitter leaf and different forms of peppers, serving as complementary and alternative medicine (CAM). However, in recent decades, there has been a tremendous upsurge in the use of CAM, a good number of which are no more than food supplements, containing basically vitamins and minerals. Kwanashie (2011) had

[71] The fermented corn starch popularly cooked for a breakfast porridge, and largely employed in weaning children, termed *ogi* in Yorubaland where this work was carried out, is known as *akamu* in Ibo, and *kamu* in Hausa.

sounded a note of safety and quality concerns about the proliferation in West African of *very expensive* CAM products from outside the sub-region (mostly Asia), the vast majority of which are not subject to regulation. Unregulated radio, television, print and word-of-mouth advertisements of unsubstantiated benefits of these products is rampart despite the fact that most carry disclaimers, and this pose dangers to the unsuspecting, uninformed and gullible public. It should be noted that it is women who mostly use these products.

Table 2: Highlights of Some Research Contributions by Kwanashie in Recalling 'Therapeutic Exiles'

Career Stage	Research Institution	Department	Perinatal Period Covered	Research Project / Publications	References
BSc	Ibadan	Biochemistry	Childhood	Changes in the β-Carotene, Vitamin A and Sugar Content During the Preparation of '*Ogi*' from Maize Varieties	Akpobi (1979b)
BSc	Ibadan	Biochemistry	Women...	Detection of Polycyclic Aromatic Hydrocarbons in Nigerian Smoked Fish	Akpobi (1979a)
MSc	Ibadan	Biochemistry	Women... Pregnancy	Drug Metabolising Capacity of Placental Tissues From Nigerian Women at Late Gestation	Kwanashie (1981, 1987, 1988)
PhD	ABU	Pharmacology...	Women... Pregnancy	Effects of Cimetidine on Female Fertility and Pregnancy Outcome in the Mouse and Rat	Wambebe *et. al.* (1990)
PhD	ABU	Pharmacology...	Labour	Action of Cimetidine on the Rat Uterus Preparation	Kwanashie *et. al.* (1987)
PhD	ABU	Pharmacology...	Breastfeeding	Effects of Maternally Administered Cimetidine During Lactation on the Development of Drug Metabolising Enzymes in Mouse Pups	Kwanashie *et. al.* (1989)
				Dose-related and Other Effects of Maternal Cimetidine Pretreatment During Lactation on Drug metabolism in Mouse Dams and Pups	Osuide *et. al.* (1990)
PhD	ABU	Pharmacology...	Childhood	Effects of Cimetidine on Drug Metabolism in Rat Pups	Ikediobi *et. al.* (1991)
Post-doc	Dundee, UK	Biochemical Medicine	Women	Interactions Between Ethinyloestradiol and Food Additives via Glucuronidation Using Human Cloned Stably Expressed UGTs	Kwanashie (1994, 2008)

3.2.1 Changes in the β-Carotene, Vitamin A and Sugar Content During the Preparation of 'Ogi' from Maize Varieties (Akpobi, 1979b)[72]

In Nigeria, maize grain (*Zea mays*) is often fermented, milled and sieved to yield *ogi* – the corn starch popularly cooked for a breakfast porridge, and largely employed in weaning children. The objective here, was to track changes in β-carotene, Vitamin A and diverse sugar levels during the local processing of different maize varieties into *ogi*. β-carotene and vitamin A were found to be higher for whole maize grain than for *ogi*, average values being 25.17 µg β-carotene/100 g whole maize; 16.00 µg β-carotene/100 g *ogi*; 13.75 µg vitamin A/100 g whole maize and 7.50 µg/100 g *ogi*. Losses were attributed to the milling and sieving processes, as well as the *ogi* wash water (supernatant) and the chaff, being discarded during the processing.

The sugars identified were glucose, fructose, sucrose, maltose, mannitol, raffinose, xylose and rhamnose. The total sugar content was found to decrease during processing of *ogi* from maize. The sucrose, glucose, fructose and mannitol of *ogi* was less than that of maize grain. The maltose, ramnose and xylose of *ogi* was more than in maize. On the whole, fermented corn was richest in simple sugars, its glucose and fructose being more than in whole grain even; which is in line with other studies that have shown fermentation to increase the nutritional attributes of foods, particularly of the micro-nutrients, vitamins.

From this work, a significant contribution to recalling therapeutic exiles lies in improved nutrition for children in particular. Since the study showed that the processing technique resulted in some losses, it was recommended that the sieving process after fermentation be omitted. Food-drug interactions are important in malnutrition, the latter of which are more likely to occur in women and children. This is particularly so in protein-energy-

[72] This, like the other BSc project on smoked fish (Akpobi, 1979a), was jointly carried out by the lecturer along with Bunmi, Ekenobi and Jeremiah with individualized reports, under the supervision of Prof Michael Fafunso.

malnutrition, where available albumin for plasma protein binding of drugs are reduced, as are liver microsomal inactivating enzymes, resulting in exaggerated drug effects and toxicity. Adequate vitamin intake (including of vitamin A), has additionally been associated with drug action; and fortification programmes have been vigorously pursued internationally by the World Health Organization (WHO) and locally by agencies such as National Agency for Food and Drug Administration and Control (NAFDAC). Appropriate adaptation and utilization of knowledge gained from the project work reported above, would be natural forms of fortification, which should be preferred. Recommendations on how to maximize the nutritional value of *ogi* made in the said project report (including suggested recipes) are a further step in recalling therapeutic exiles.

3.2.2 Detection of Polycyclic Aromatic Hydrocarbons in Nigerian Smoked Fish (Akpobi, 1979a)[73]

In this project which also dealt with food, the significance to recalling therapeutic exiles is in Toxicology - that specialized aspect of Pharmacology that deals with the adverse effects of agents some of which are contaminants of our foods (and environment), including the prevention and amelioration of such adverse effects. Nigerian smoked fish obtained from local markets were examined to see if any PAH was present. Solvent extraction produced an oil concentrate which contained PAHs found to be present in all smoked fish species utilized for this study. The principal PAHs so detected were: anthracenes, benzpyrenes and other unidentified PAHs. Methods of fish preservation other than smoking were discussed.

The smoking of fish and other foods is usually a task for women folk in many communities. This exposes them to intake of PAHs, many of which are mutagenic and carcinogenic to the lungs, liver and other organs. Furthermore, we shall see a possible association with the ability of the placenta to metabolise drugs as my MSc research (described next) would show.

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[73] This, like the other BSc project on Ogi (Akpobi, 1979b), was jointly carried out by the lecturer along with Buami, Ekemobi and Jeremiah with individualized reports, under the supervision of Prof Godwin Emerole.

3.2.3 Contributions of the Food Studies to Recalling Therapeutic Exiles

The *ogi* study will lead to enhanced nutrition for all, children in particular. The smoked fish project is a pointer to possible exposure of women to carcinogenic PAHs as an occupational or routine home-environment hazard. Both should translate to better health promotion.

3.3 MSc Research on Drug Metabolism by the Human Placenta

My MSc research project was on drug metabolizing capacities of placentae taken from Nigerian women following caesarean deliveries. Levels and activities of a spectrum of drug metabolizing enzymes were determined and compared to those of rat liver, the latter being the reference standard in drug metabolism studies. Three distinct aspects of this work are described below.

3.3.1 Drug Metabolising Capacity of Placental Tissues From Nigerian Women at Late Gestation (Kwanashie, 1981 and 1987)

Late gestation placental tissues obtained from Nigerian women showed a definite but lower capacity to metabolise drugs when compared to rat liver. N-demethylation of aminopyrine, O-demethylation of p-nitroanisole and hydroxylation of 3,4 benzopyrene (3,4-BP) were demonstrated. NADPH cytochrome P-450 reductase activity was also observed in both tissues. Reduced glutathione and gluthation reductase assays revealed a potential for gluthatione conjugating system. However, aniline hydroxylase activity (AH) present in rat hepatic microsomes, was absent in placental microsomes. Hydroxylation of 3,4 BP which had elsewhere been observed only in the placentae of cigarette-smoking mothers, was observed in the placentae of Nigerian women, who though were non-smokers, were chronically exposed to other sources of PAHs. Such exposure could be from smoking of foods (e.g. fish as seen in the BSc project), cooking with firewood or other fuel sources that generate smoke. Consumption of smoked foods is also associated with intake of PAHs and their ill-effects.

3.3.2 Subcellular Localization of Drug Metabolising Enzymes in the Human Placenta at Term (Kwanashie, 1987)

While most drug metabolism takes place in the smooth endoplasmic reticulum of liver cells, the intracellular site for drug metabolism may differ particularly for organs other than the liver. The localization of intracellular sites for drug metabolism is important for a truly biochemical understanding of the role played by the organs concerned in the metabolism of drugs and other xenobiotics in normal and disease states. The objective of this study was to locate the primary site of key drug metabolizing reactions undertaken by the human placenta - an organ whose role in the inactivation and activation of foreign compounds was not and is still not appreciated fully.

Nuclei, mitochondrial, microsomal and cytosolic sub-cellular fractions were obtained by standard procedures of homogenization and ultra-centrifugation from human placenta at term. Each of these fractions was used as enzyme source in the assay of aryl hydrocarbon hydroxylase (AHH), p-nitroanisole O-demethylase (p-NAO-D), glutathione reductase (GR) and NADPH cytochrome C reductase. Both cellular fractionation and enzyme assays were carried out at 0-4^{O}C. The relative specific activity for each subcellular fraction vis-à-vis percent of total protein was the criterion used to determine the primary, secondary and other sites of activity of each enzyme studied.

All four fractions showed varied levels and activities of each of the enzymes studied. AHH (a bioactivation oxidative enzyme) and p-NAO-D (a typical oxidative enzyme), were mostly located in the microsomal fraction as is typical of most enzymes responsible for drug oxidations. GR was mostly located in the cytosol and microsomes, again typifying most conjugation systems. However, NADPH cytochrome C reductase activity was found more in mitochondrial and nuclei fractions than in the microsomes. Thus, this routinely employed marker enzyme for microsomes may not be employed as such for placental microsomes.

In conclusion, sub-cellular localization of these drug metabolizing enzymes in the human placenta was similar to what obtains in the liver, except with respect to the cytochrome P_{450}-dependent NADPH cytochrome C reductase.

3.3.3 A Rapid Precipitation Method for Microsomes Isolation From Human Placental and Rat Liver Homogenates

(Kwanashie, 1988)

The most commonly used technique of total differential centrifugation for isolation of smooth endoplasmic reticulum (microsomes) was time consuming and not always feasible beyond the post-mitochondrial 10,000 g supernatant, especially for laboratories in resource-poor settings where high speed ultracentrifuges may not be available. This study was undertaken to develop a rapid precipitation method for isolating microsomes by evaluating two precipitation methods.

To 15 ml aliquots of microsomal fractions obtained from rat liver and human placental tissues, were added 0.25 ml, 0.50 ml, 1.00 ml and 2.00 ml of 0.2 M sodium acetate buffer (pH 4.0); and 0.6 ml of 250 mM magnesium chloride plus 0.3 ml of 200 mM calcium chloride. Buffer was added to make the homogenate volume 20 ml. Whereas it was possible to precipitate microsomes from rat liver employing both the sodium acetate and the magnesium chloride/calcium chloride methods, the latter failed for placental tissues. Of the variant sodium acetate procedures, use of 0.50 ml buffer was found to be optimal in terms of pH (final being 5.4), microsomal yield, microsomal protein and enzyme assays. Adoption of this protocol removes pH adjustment delays of the basic sodium acetate method, thus providing a suitable means of isolating microsomes with the dispatch required in materno-foetal enzyme studies.

3.3.4 Contributions of the Placenta Studies to Recalling Therapeutic Exiles

These studies on placental metabolism of drugs emphasized the role placenta could play in detoxification of drugs and other foreign compounds, thereby protecting the foetus. The studies also exposed possibilities of toxicity to both mother and child as a result of placental metabolism of drugs. In particular, placental AHH was believed to be inducible by PAHs present in cigarette smoke, and is ordinarily absent in non-smokers. Measurable AHH activity therefore in the placentae from these subjects who were non-smokers, was suggestive that perhaps they were exposed to other

sources of PAHs in the environment such as smoked foods and firewood smoke. Such knowledge would normally precede prevention of toxicity. The enhanced methodologies described from my work made such studies easier to conduct, providing much needed information about drug effects when administered during pregnancy (and even during labour).

3.4 PhD Research on the Effects of Cimetidine in the Perinatal Period of the Mouse and Rat

Cimetidine (Tagamet®, Smith, Kline and French[74]) was developed from a logical manipulation of the structure of histamine and became the first drug ever to reach more than $1 billion a year in sales, thus making it the first blockbuster drug (Whitney, 2006). It acts by competitive inhibition of histamine at H_2-receptors in the parietal cell of the gastric mucosa. The drug is well absorbed from the gastrointestinal tract (GIT), partly metabolized in the liver to mainly the sulphoxide and excreted mostly unchanged in the urine. Cimetidine is also excreted into bile and breast milk. Side effects though many, are generally minor, infrequent and / or reversible. Four mechanisms underlying cimetidine-drug interactions were known, the most important being inhibition of drug metabolism. Compared to other anti-ulcer drugs in use in the 1980s, cimetidine was superior although its use and safety in the perinatal period was poorly researched and documented. Cimetidine is slowly transported across the placenta but was reportedly lacking in teratogenic effects. When administered in pregnancy, the drug was associated with adverse effects on the sexual development and behavior of the male offspring. In obstetric anaesthesia, cimetidine played a formidable role in prophylaxis against acid aspiration pneumonitis and was superior to the older approaches including diverse intubations, application of cricoids pressure, antacids and anticholinergics. The drug was also used in children in acid peptic diseases and related conditions. Despite these actual and potential uses of the drug, the efficacy-safety profile of cimetidine in the perinatal period was not clearly established. The objective of my PhD research was to study some of the controversial, unclear and unresearched aspects using laboratory animals.

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[74] Through a series of amalgamations with other pharmaceutical companies, Smith, Kline and French later became GlaxoSmithKline.

3.4.1 Effects of Cimetidine on Female Fertility and Pregnancy Outcome in Mouse and Rat (Wambebe *et. al.*, 1990)

Cimetidine, 100 mg/kg administered i.p. daily for 2 weeks to female adult mice did not influence their mating power or fertility, the pregnancy rate being unaltered. When administered i.p. daily to mice and rat during the 1st, 2nd and 3rd trimester (50 mg/kg), and throughout pregnancy (both 50 and 100 mg/kg), cimetidine was found not to affect the general outcome of pregnancy. A number of parameters investigated, namely: abortion, gestation period, congenital physical deformities, litter size and viability, neonatal deaths, lactation, weaning and attainment of puberty, were not affected by prenatal administration of cimetidine. However, cimetidine 100 mg/kg i.p. daily throughout pregnancy resulted in weight loss in dams and even in the indirectly exposed pups, the latter effect being carried into adulthood.

3.4.2 Effects of Cimetidine and Its Interaction With Oxytocin on the Isolated Rat and Rabbit Uteri (reported partly in: Kwanashie *et. al.*, 1987, 1990 and 1992)

No major qualitative species differences were observed either in the intrinsic activity, or in the responsiveness to oxytocin and cimetidine, of three sensitive-types of rat and rabbit uteri namely, quiescent, non-quiescent and pregnant. Cimetidine (100-1,000 μg/ ml) like oxytocin (10-100 ηg/ml), exhibited concentration-dependent spasmogenic actions; with cimetidine found to be less potent by $1.6\text{-}3.7X10^{-4}$ - Figures 2 and 3. However, cimetidine-induced contractions were typically charcaterised by multiple, gradually increasing peaks preceded by concentration-related latent periods. In contrast, contractions due to oxytocin were more immediate and characterized by single peaks on the non-pregnant uterus. The effects were synergistic when both cimetidine and oxytocin were used simultaneously on the non-perfused and perfused uteri, a potentiation that was concentration-dependently related to cimetidine (Figure 4).

These effects of cimetidine were observed at concentrations that were 10^3 times higher than those likely to be encountered clinically. The administration of cimetidine to decrease acid secretion in obstetrics may therefore not interfere with the normal progress of labour. The differences between the actions oxytocin and cimetidine may derive from different mechanisms. Receptor characterization experiments showed that whereas oxytocin acted on oxytocic receptors, cimetidine's action on the uterus may not

involve receptors, but rather a combination of calcium ion modulation and the synthesis-cum-release of prostaglandins.

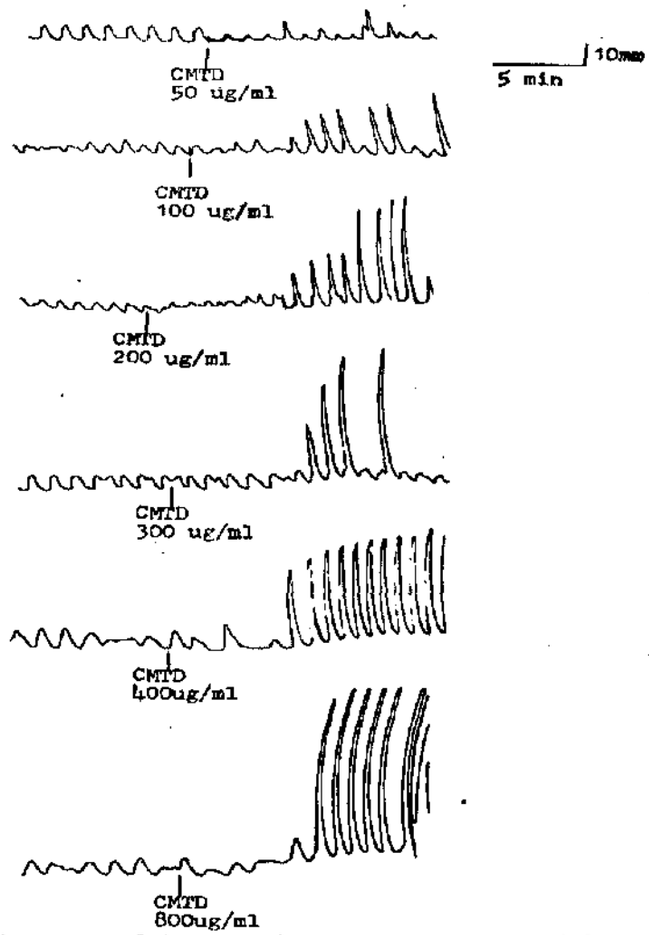


Figure 2: Responses of the non-quiescent rat uterus to graded concentrations of cimetidine over 15 minutes.

Note that amplitude and rate of contraction increased while the latent period decreased as cimetidine (CMTD) concentration increased.
Microdynamometer sensitivity was 1/10.

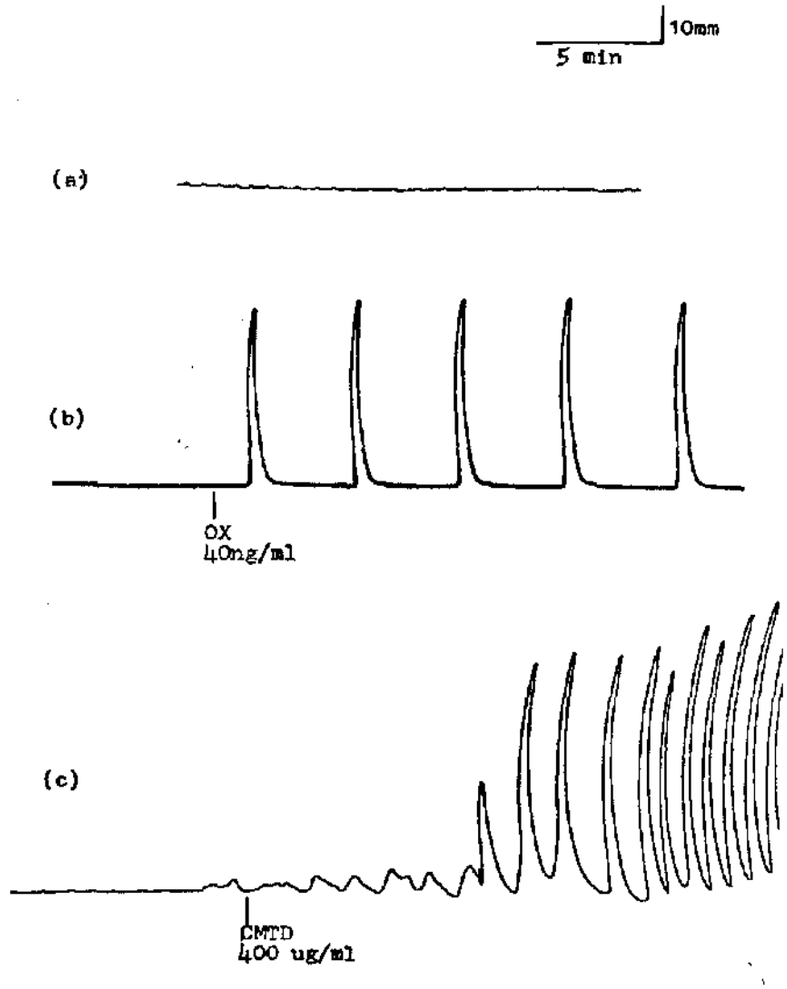


Figure 3: Effect of oxytocin and cimetidine on the frequency of contraction of the quiescent rat uterus.

The rate of contraction due to cimetidine (CMTD) 400 µg/ml was 3-fold that of oxytocin (OX) 40 ηg/ml.
Microdynamometer sensitivity was 1/10.

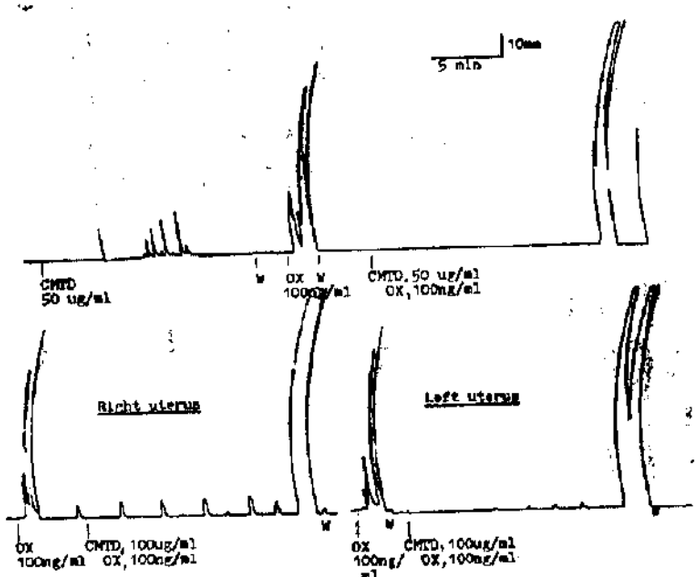


Figure 4: Interaction between oxytocin and cimetidine on the non-perfused rabbit uterus

Cimetidine (CMTD) 50 and 100 μg/ml dose-dependently potentiated the amplitude of contraction to oxytocin (OX) 100 ηg/ml. Microdynamometer sensitivity was 4/10.

3.4.3 Matters Arising From the Cimetidine-Uteri Experiments and Future Research Goal

Two issues arising from the cimetidine-uteri experiments are worthy of mention. First, my efforts to use human uterine myometrial strips to confirm or otherwise, the above effects observed with rat and rabbit uteri, did not materialize because I did not receive the requisite ethical approval from the teaching hospital, despite frequent enquiries on my part. Incidentally, I was not refused either, and perhaps now is an appropriate time to call on ethical committees to review such research proposals with greater dispatch. The post-surgery uterine strips I needed for the research plus the *in vitro* perfusion of the placenta (contained in the same proposal), would not have been detrimental to the women from

whom they would have been derived, since there are discardable tissues. Secondly, my work showed *agonist* effects of cimetidine on uterine and intestinal smooth muscle (latter not presented in this lecture). Well known as an antagonist at histamine H_2 receptors, this agonist property I observed remains worthy of further investigation. Histamine H_3 and H_4 receptors have been described since my studies, that are unrelated to the spasmogenic actions of cimetidine I had seen with uterine and intestinal smooth muscles. Could this be due to cimetidine acting on yet another histamine receptor? Could it be a non-histamine receptor? Could the action be non-receptor related? Or could the mechanisms I had postulated at the time be sorely responsible? These and other unanswered questions warrant my further investigations, and indeed the attention of other researchers.

While cimetidine may no longer be the anti-ulcer 'magic bullet' it was in the 1980s due to availability of better H_2 receptor antagonists such as ranitidine, discovery/development of better anti-acid drugs such as omeprazole, introduction of antibiotics into treatment of peptic ulcer disease, etc, etc, experience has shown that not abandoning old (and even 'cursed') drugs is scientific and therapeutic wisdom! For, despite its teratogenicity and axonal neuropathy, thalidomide has found new uses in treating leprosy, graft-versus-host-disease (GVHD) plus other severe and disabling conditions where standard anti-inflammatory or immunosuppressive agents have failed (Medscape, 2000). Other new uses for thalidomide include treatment of multiple myeloma and other types of cancers when combined with dexamethasone (Jones, 2008). Thus, cimetidine may yet be an evolving biomedical saga waiting to be unearthed[75].

[75] *Sir James Whyte Black (1924-2010) was a Scottish doctor and* pharmacologist who was awarded the 1988 Nobel Prize in Medicine for work leading to discovery of histamine H_2 receptor, the development of cimetidine as an H_2 receptor antagonist; as well as that of propranolol, the non-selective β-adrenergic blocker.

3.4.4 Effects of Maternally Administered Cimetidine During Lactation on Drug Metabolim in Mouse Dams and Pups

(reported in: Kwanashie *et. al.*, 1989 and Osuide *et. al.*, 1990)

Maternally administered cimetidine inhibited drug metabolizing enzymes in both dams and pups. The inhibition of drug metabolism in adult dams which received cimetidine directly was lower than that observed in pups which could only have received a small fraction of the administered dose through the milk. In 2-weeks old pups, at a maternal cimetidine pretreatment dose of 50 mg/kg/day, APN-D activity was reduced by 58.4% in male and 62.1% in female test pups compared to the controls. In the same manner, pentobarbitone sleeping time (PBST) was prolonged by 28.7% in male and 65.9% in female test pups. Using PBST determinations as an inversely related index of drug metabolizing capacity, maternal cimetidine pretreatment with 50 mg/kg/day for 6 weeks, resulted in quantitative as against qualitative inhibitory effects on the development of drug metabolizing enzymes in pups from age 2 to 10 weeks. AMN-D, AH and PBST determinations in both dams and pups following maternal pretreatment with 15, 25 and 50 mg/kg/day cimetidine showed inhibitions that were dose-dependent. Of the three indices investigated, AH was the least influenced by cimetidine pretreatment. In general, the inhibition of drug metabolism was more pronounced in the female.

In summary, maternally administered cimetidine during lactation inhibited the levels of drug metabolizing enzymes in mouse pups much more than it did in the dams which received the drug. These effects varied with the dose, sex and substrate. Obviously, the already poor ability of newborn mice to metabolise drugs was further jeopardized by maternal administration of cimetidine.

3.4.5 Effects of Cimetidine on Drug Metabolim in Rat Pups

(Ikediobi *et. al.*, 1991)

The effects of cimetidine on drug metabolism were also studied in male and female rat pups and compared to similar effects in adult rats. As in adult rats, cimetidine 50 mg/kg/day i.p. for 7 days in the 2^{nd}, 3^{rd}, 4^{th} or 5^{th} weeks of life resulted in prolonged PBST (equivalent to diminished pentobarbitone hydroxylase

activities), particularly when administered during the 3rd week. These effects of cimetidine were reversible since they continued only up to 2 weeks in males and 4 weeks in females, but by the 6th week were no longer observed. Pretreatment with cimetidine 15, 25 and 50 mg/kg/day i.p. for 7 days, resulted in a dose-dependent inhibition of APN-D and AH as well as a prolongation of PBST in both pups and adults, AH being the least affected. In general, female pups were more adversely affected than male pups and adults.

3.4.6 Contributions of the Cimetidine Studies to Recalling Therapeutic Exiles

These aforementioned studies which deal with potential use of cimetidine in women of child-bearing age, during pregnancy, labour and breastfeeding as well as in the very young should make its use in the perinatal period more rational. The therapeutic and toxicological implications are manifold. Although these studies were carried out in animals, rodent models that can be extrapolated to man were used (e.g. rat uterus). Thus, the use of cimetidine during pregnancy and labour appear to be safe. However, the use of cimetidine during breastfeeding and in the young requires caution due to its ability to inhibit drug metabolism with ample potential for drug-drug interactions.

It is pertinent to draw attention to the fact that by 2012, GlaxoSmithKline had sold Tagamet® (cimetidine) along with 16 other brands to Prestige Brands, and the drug is now available as an over-the-counter medicine for heartburn in many countries. Yet its safety profile in the perinatal period in actual clinical situations remains largely unknown!

3.5 Post-Doctoral Research on the Metabolism of the Oral Contraceptive, Ethinyloestradiol

Part of my contributions to perinatal pharmacology relates to women of child-bearing age, sometimes put at 15-45 years. For women who are sexually active within this population, drug use in general, could easily translate to drug use in pregnancy, with possible negative implications.

Whereas other studies in the female described so far, involved drugs taken by the male as well, the use of traditional oral contraceptive drugs are exclusive to women[76]. Our studies with ethinyloestradiol, using tissue culture techniques, showed possibilities of interactions with food, cosmetic and pharmaceutical additives via drug metabolism, specifically glucuronidation (Kwanashie, 1994 and 2008; Kwanashie and Burchell, 1994)[77]. Inhibition of the glucuronidation of ethinyloestradiol by antioxidants like octyl gallate, propyl gallate, and colouring agents like erythrosine B, tartrazine, may lead to increased blood levels of the contraceptive and toxicities, including the genesis of certain types of cancer.

3.5.1 Interactions Between Ethinyloestradiol and Food, Cosmetic and Pharmaceutical Additives Via Glucuronidation (Kwanashie, 1994)

Isolated human Uridine di-phoshate Glucuronosyl Transferase (UGT) cDNAs had been stably expressed in HepG-2 or HuH-7 liver cell lines (HP1, HP2, HP3), and in Hek293 kidney cell line (HP4) using V79 Chinese hamster fibroblast cells, with expression of the transport proteins being assessed by immunoblotting (Wooster *et. al.*, 1991).

Using these V79 cells transfected with UGT HP1, HP3 and HP4, as well as rat liver microsomes (RLM), the glucuronidation of several drugs being a battery of endobiotics and xenobiotics (against 1-naphthol as standard), were examined through *in-vitro* incubation with ^{14}C-UDPGA. This was followed by thin layer chromatography (TLC), leading to separations of any glucuronides formed as described by Visser *et. al.* (1993). The major criteria for drug selection were frequent use in the clinical setting and proven or possible glucuronidation; and so included NSAIDs, H_2-receptor antagonists, ethinyloestradiol and food/cosmetic/pharmaceutical additives. That V79HP3 has similar affinities towards the semi-

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[76] Male oral contraceptives are currently being developed.

[77] These studies were conducted under the supervision of Prof Brian Burchell at the Department of Biochemical Medicine, Ninewells Hospital and Medical School, University of Dundee, Dundee, Scotland; with support from The Wellcome Trust, UK

synthetic oestrogen-ethinyloestradiol and some food additives led to their further investigation. No glucuronides were detected for chloroquine, cimetidine, colchicine, paracetamol, probenicid, ranitidine, thyroxin and tri-iodothyronine. Since many of these drugs are known to undergo glucuronidation, their non-detection may be due to involvement of UGTs other than those listed above; or to limitation of the assay procedure. Glucuronide formation was nonetheless demonstrated with ethinyloestradiol (V79HP3, V79HP4 and RLM), the food additive, octyl gallate (V79HP3, V79HP4 and RLM) as well as propofol (V79HP4 and RLM) - see Table 3. From this, interaction between ethinyloestradiol and octyl gallate via transfected (HP3) V79 cells was an obvious possibility and was therefore explored further.

3.5.2 Interaction Studies Between Ethinyloestradiol and Food Additives (Kwanashie, 2008)

Ethinyloestradiol is the most commonly used oetrogen in combined oral contraceptive preparations, and as such, the potential for its interaction with commonly used food additives is real, which could result in therapeutic and / or toxicological consequences. Octyl gallate is an anti-oxidant which is widely used in the food, cosmetic and pharmaceutical industries. This study was undertaken to investigate possible interactions between ethinyloestradiol and octyl gallate, as well as other food additives.

A radioactive assay technique using ^{3}H-ethinyloestradiol was employed and optimized for substrate concentration (200 µM), incubation time (30 minutes), pH (7.5) and amount of protein (0.15 mg). Interaction studies were carried out between ethinyloestradiol, octyl gallate, propyl gallate (both anti-oxidants) and gallic acid (from which they are derived). Further interaction studies were carried out between ethinyloestradiol and other commonly-used food additives / constituents; namely: vanillin, saccharin, vitamin C, vitamin E, protocatechuic acid, catechin, benzoic acid, p-hydroxy benzoic acid, 4-chlorobenzoic acid, 2,5-dihydroxybenzoic acid, tartrazine, erythrosine B and tannic acid. The concentrations of each of the food additives was 50 µM relative to 100 µM for the oestrogen. Octyl gallate (10-50 µM) was shown to inhibit the glucuronidation of ethinyloestradiol (100 µM) in a concentration-dependent manner (Table 4).

Table 3: Drugs Glucuronidated by One or More Transfected V79 Cells or Lubrol-activated Fed Rat Liver Microsomes

Drug	V79HP1	V79HP2	V79HP3	Lub-FRLM
1-Napthol	26.98	1.06	1.20	20.77
Propofol	0	Nd	7.63	1.06
Ethinyloestradiol	0	0.48	0.10	Nd
Octyl gallate	Nd	2.61	17.5	Nd
Bilirubin*	0.008	0.139	0.008	0.770

V79HP = Human cloned stably expressed UGTs in
V79 Chinese hamster fibroblast cells
Lub- = Lubrol-activated; FRLM = Fed Rat Liver Microsomes
Glucuronidation estimated by Uridine di-phoshate Glucuronosyl Transferase (UGT) in nmol/min/mg
*Spectrophotometric assay method; others by TLC
Nd = Not done / or determined with poorly-active cell homogenate

Table 4: Concentration-dependent Inhibition of Ethinyloestradiol Uridine di-phosphate Glucuronol Transferase by Some Food Additives

Concn (μM)	Gallic acid	Propyl gallate	Octyl gallate	Erythro-sine B	Tartra-zine	Tannic acid
0	100	100	100	100	100	100
10	95.90	94.08	80.20	17.68	107.96	72.80
30	98.71	87.69	63.09	15.48	104.68	46.40
50	97.67	72.89	60.28	10.21	78.96	21.01

*Control = 100%
Incubation concentration: ethinyloestradiol = 100 μM,
others = 50 μM.

Its close relative, propyl gallate, a less favoured anti-oxidant, also showed concentration-dependent inhibition of the glucuronidation of ethinyloestradiol. Whereas octyl gallate was the more potent of the two as inhibitors, gallic acid had no effect on the glucuronidation of ethinyloestradiol, indicating a Structure Activity Relationship (SAR).

Propyl and octyl gallate were subsequently shown to be weak (20-39%) and moderate (40-59%) inhibitors respectively, indicating that the longer the side chain, the more potent the ester was, as an inhibitor - see Table 5. Vanillin, saccharin, vitamin C, vitamin E, protocatechuic acid, catechin, benzoic acid and its derivatives - p-hydroxybenzoic acid, 4-chlorobenzoic acid and 2,5-dihydroxybenzoic acid (a.k.a. gentisic acid) had little (<20% inhibition) or no effect on the glucuronidation of ethinyloestradiol. On the other hand, tested colouring agents were found to be inhibitors of the glucuronidation of ethinyloestradiol. While tartrazine was found to be a weak inhibitor (20-39%), erythrosine B and tannic acid were shown to be strong inhibitors (60-79%). Thus, the potency of the indicated food additives as inhibitors of ethinyloestradiol glucuronidation, in decreasing order was as follows: erythrosine B > tannic acid > octyl gallate > propyl gallate > tartrazine. As with the gallic acid esters, concentration-dependent inhibitions were also shown to be the case for erythrosine B and tannic acid (Table 6).

Table 5: Inhibition of Ethinyloestradiol Uridine di-phosphate Glucuronol Transferase by Some Food Additives

Group	Drug	Percent UGT Left*	Verdict
Gallic Acid and their Esters	Gallic acid	97.67	No effect
	Propyl gallate	72.89	Weak inhibition
	Octyl gallate	60.28	Moderate inhibition
Vitamins	Vitamin C	100.42	No effect
	Vitamin E	97.84	No effect
Benzoic Acid and their Derivatives	Benzoic acid	99.11	No effect
	p-hydroxy benzoic acid	105.17	No effect
	4-chloro benzoic acid	99.76	No effect
	2,5-dihydroxy benzoic acid	101.60	No effect
Colouring Agents	Erythrosine B	10.21	Very strong inhibition
	Tartrazine	78.96	Weak inhibition

Sweetening / Flavouring Agents, etc	Tannic acid+	21.01	Strong inhibition
	Saccharin	104.54	No effect
	Vanilin	92.66	No effect
	Catechin	100.20	No effect
	Protocatechuic acid	99.32	No effect

*Control = 100%; + = Natural occurring plant component
Incubation concentration: ethinyloestradiol = 100 μM,
others = 100 μM

Researcher's Scale for Designation of Potency of Inhibition (% Ethinyloestradiol left-Verdict): >85 No effect, 81-85 Very weak, 61-80 Weak, 41-60 Moderate, 21-40 Strong, <21 Very strong

Table 6: Concentration-dependent Inhibition of Ethinyloestradiol Uridine di-phosphate Glucuronol Transferase by Erythrosine B

Erythrosine B Concn (μM)	Per cent UGT Left*
0.1	94.75
0.2	90.08
0.5	78.64
2.0	40.77
5.0	24.42
10.0	17.68
30.0	15.48
50.0	10.21

*Control = 100%
Incubation concentration: ethinyloestradiol = 100 μM

Although not carried out due to time constraint, these interactions could have been confirmed *in-vivo* by addition of the oestrogen and food additive(s) simultaneously to whole cells in tissue culture medium, in order to assess competition of the two substrates for the enzyme (HP3). Analysis of the glucuronide formation would then have been by high performance liquid chromatography (HPLC) with the use of β-glucuronidase as well as radioactive assays (Ebner *et. al.*, 1993).

3.5.3 Contributions of the Ethinyloestradiol Studies to Recalling Therapeutic Exiles

The significance of the ethinyloestradiol studies was that inhibition of the glucuronidation of oestrogen by food additives (and co-administered drugs metabolized reasonably by V79HP3 cells as well as by rat liver), may lead to increased blood levels and toxicities of the oestrogen, including the genesis of certain types of cancer. Based on my data described above, prediction of ethinyloestradiol interaction with other food additives can reasonably be made. Thus, clinicians who prescribe ethinyloestradiol and even the women themselves who take this oral contraceptive should be mindful of the additives in the foods and medicines they take concurrently.

3.6 Contributions Relating to Malaria, HIV/AIDS and Sickle Cell Disorder, Etc

The contributions described in this section represent research conducted outside my education and training, and include those of students supervised by me, highlights of which are summarised in Tables 7 and 8. Malaria as a disease is no respecter of age and sex although pregnant women and children (especially those below the age of 5) are particularly susceptible. Thus, research involving the disease itself and/or antimalarial drugs are directly relevant to the perinatal period. Similarly, HIV/AIDS is more common in females, and hence research in this area is of primary benefit to women. Furthermore, as will be argued later, sickle cell disorder is primarily, a disease of children. Some details about the old antimalarial drug, quinine, which is still in use in severe, complicated and cerebral malaria, especially in East Africa (Kwanashie and Kwanashie, 2011), and is used in folkloric medicine for illegal abortions is reported in 3.6.1. Our surveys confirmed that the specific most sold antimalarial drugs in the Zaria area was artemether-lumenfantrine followed by artesunate-amodiaquine (Kwanashie *et. al.*, 2011); the two artemisine derivatives (artemether and artesunate) having earlier been investigated by our team, administered alone, and together with antiretroviral drugs.

Table 7: Other Research Contributions by Kwanashie in Recalling 'Therapeutic Exiles': Malaria and HIV/AIDS

Disease / Other Conditions	Perinatal Period Covered	Additional Information	Research Project / Publications	References
MALARIA	Women... / Pregnancy	Old antimalarial drug, still in use for complicated / cerebral malaria	Pharmacological Evidence for Cautious Use of Quinine in Late Pregnancy and its Frequent Failure as an Abortifacient	Kwanashie *et. al.* (2002)
	Women... / Pregnancy	Newer antimalarial drug (artemether)	Some Pregnancy-related Effects of Artemether in Laboratory Animals	Ejiofor *et. al.* (2006)
	Women... / Pregnancy	Newer antimalarial drug (artemether)	Effect of Artemether on Mid-Gestation Period of Pregnancy in Rats	Ejiofor *et. al.* (2007a)
	Women... / Pregnancy	Newer antimalarial drug (artesunate)	Preliminary Studies on the Effects of Artesunate on Rat Uterine Smooth Muscle	Ayanwuyi *et. al.* (2009)
MALARIA & HIV/AIDS	All	Artesunate-Lamivudine co-administration	Effects of Lamivudine-Artesunate Coadministration on Some Pharmacological and Biological Parameters in Healthy and Disease State Laboratory Rodents	Olurishe (2010), Etc
	All	Artemether-Nevirapine co-administration	Exploratory Studies on the Effect of Co-administration of Artemether and Nevirapine in Normal and Diseased Rodents	Anafi (2014), Etc

Table 8: Other Research Contributions by Kwanashie in Recalling 'Therapeutic Exiles': Sickle Cell Disorder and Postpartum Haemorrhage

Disease / Other Conditions	Perinatal Period Covered	Additional Information	Research Project / Publications	References
SICKLE CELL DISORDER	Children mainly	The disorder	Incidence and Prevalence of Sickle Cell Anaemia in Northern Nigeria	Kwanashie *et. al.* (1998a)
	Children mainly	The disorder	Pharmacological and Non-Drug Management of Sickle Cell Anaemia at ABUTH, Zaria, Nigeria	Kwanashie *et. al.* (1998)
	Children mainly	Siculine syrup	Pharmacological Studies on Siculine - I: Antisickling and Analgesic Activities	Ejiofor *et. al.* (2007b)
	Children mainly	Siculine syrup	Phytochemical, Antimicrobial and Pharmacological Studies on 'Siculine' - A Herbal Remedy for Sickle Cell Anaemia	Ejiofor *et. al.* (2008)
	Children mainly	Siculine syrup	Pharmacological Studies on Siculine Syrup II: Effects on Various Smooth Muscles	Kwanashie *et. al.* (1998c)
			Pharmacological Studies on Siculine Syrup. II: Effects on Smooth, Skeletal and Cardiovascular Muscle Preparations	Kwanashie *et. al.* (2009)
POSTPARTUM HAEMORRHAGE	**Women in labour**	Misoprostol	A Randomised Clinical Trial Comparing the Effects of Oxytocin Injection and Oral Misoprostol Tablets in the Prevention of Postpartum Haemorrhage in Maiduguri Nigeria	Uthman *et. al.* (2011)

While Ejiofor *et. al.* (2006 and 2007a) had shown that artemether did not adversely affect the outcome of pregnancy in *in vivo* experiments in rats, Ayanwuyi *et. al.* (2009) reported that artesunate produced concentration-dependent contractions of the isolated rat uterus (*in vitro*) just like oxytocin though less potent, suggesting that its administration during pregnancy and/or labour, may affect the outcomes. The effects of these first line antimalarial drugs on pregnancy from various angles definitely need further investigations. Hence, another MSc student of mine (Mrs Maryam Usman) has just completed her laboratory work investigating the effects of old and new antimalarials on the oestrous cycle and uterine contractility in rats.

The research on antiretroviral drugs were undertaken as PhD research by students I had supervised, and these focussed on interactions with antimalarial drugs using laboratory animals (3.6.2). Dr Temidayo Olurishe had looked at the effects of lamivudine-artesunate coadministration on some pharmacological and biological parameters in healthy and disease state laboratory rodents (Olurishe, 2010), from which he has published extensively (e.g. Olurishe *et. al.*, 2011a,b, 2012a,b and 2013). Dr (Mrs) Sherifat Anafi more recently concluded exploratory studies on the effect of co-administration of artemether and nevirapine in normal and diseased rodents (Anafi, 2014), and is in the process of publishing her findings (Anafi *et. al.*, 2013a,b). Mrs Fatima Abdurahman had also just concluded a pharmacoeconomic analysis of HIV/AIDS management involving both adult and paediatric patients in Kano (Abdurahman, 2014).

Studies on sickle cell disorder itself and on siculine syrup, a herbal remedy purported to be useful in its treatment (most of which were conducted by myself, and by Dr Janet Ejiofor for her MSc Pharmacology project), are reported in 3.6.3. In 3.6.4, the use of misoprostol in managing postpartum haemorrhage investigated by Dr Sadiq Uthman for his PhD, evaluation of drug use and medication errors in paediatric patients investigated by Dr Basheer Chedi (also for his PhD), and other contributions relevant to the discourse, are summarized. Publications arising from all of these studies are described in those sub-sections.

I have included briefs about some of these students' contributions in my presentation because the research projects were

initiated and supervised by me with the purpose of providing relevant data towards recalling women and children from therapeutic exile. By thus grooming the students to make perinatal-cum-paediatric pharmacology their life-long research priority also, one has the hope and expectation of achieving a multiplier effect. Additionally, all their publications referred to, were co-authored by me (see reference list).

3.6.1 Pharmacological Evidence for Cautious Use of Quinine in Late Pregnancy and its Frequent Failure as an Abortifacient (Kwanashie *et. al.*, 2002)

Quinine, the principal alkaloid from *Cinchona* bark is an antimalarial agent that can be life-saving in multi-drug resistant, complicated or cerebral malaria. Its use in pregnancy however, is fraught with uncertainties since quinine is believed to be an abortifacient in high doses; and a teratogen. The objective of this study was to determine the pharmacological action of quinine on the isolated rat uterus, a model that can be meaningfully extrapolated to man. Non-pregnant and pregnant uterine preparations were set up in organ baths filled in either non-perfused or oxytocin-perfused manner, with De-Jalon solution at $37^{O}C$ and challenged with quinine and/or oxytocin. Amplitudes and rates of contractions were recorded using a microdynamometer. The results showed that unlike oxytocin (20-320 ηg/ml) which contracted the uterus concentration-dependently, quinine (120 μg/ml-1.2 mg/ml) had no agonist effect on the non-pregnant uterus. Furthermore, it was shown that quinine blocked the rhythmic contractions of the pregnant uterus, even mimicking relaxation. Quinine (480 μg/ml) also decreased the amplitude of 160 ηg/ml oxytocin-induced contractions in the non-perfused uterus to 84% and 78%. In 10 ηg/ml oxytocin-perfused uterus, the effect was shown to be concentration-dependent since amplitudes were decreased to 89% and 43% following pretreatment with 120 and 240 μg/ml quinine respectively. Corresponding decreases of contraction rates, also in the perfused uterus, were to 71% and 26%. These results negate the widely held view that quinine has oxytocic action. The results also suggest that when used in late pregnancy, quinine could inhibit the action of endogenous oxytocin and may therefore interfere with the initiation of labour at

term. In addition, the data explains, at least in part, the frequent failure of quinine when employed as an abortifacient.

3.6.2 Effects of Antimalarial-Antiretroviral Co-administration (reported in Olurishe, 2010, Olurishe *et. al.*, 2011a,b, 2012a,b & 2013 and Anafi, 2013a,b & 2014)

In summary, Olurishe showed that artesunate possessed analgesic properties, and that piroxicam-mediated analgesia was significantly reduced when co-administered with the antimalarial (Olurishe *et. al.*, 2011a). Concurrent lamivudine-artesunate administration resulted in histopathological changes in rat liver and kidney (Olurishe *et. al.*, 2011b, 2012a and 2013). Olurishe (2012b) also showed that glucose tolerance was altered when lamivudine was administered with artesunate, a possible advantage since hypoglycaemia is often a complication of malaria. Anafi *et. al.* (2013a) had reported antimalarial effect for the antiretroviral drug, nevirapine. Additionally, nevirapine was shown to abolish the analgesic effect of artemether in malaria-infected mice (Anafi *et. al.* 2013b). Idemyor (2007) had likened the interactin of HIV and malaria to two elephants colliding; which these drug interactions and co-toxicities seemed to corroborate. However, it should be noted that all the drug interactions were not necessarily bad (e.g. Olurishe *et. al.*, 2012b).

3.6.3 Studies on Sickle Cell Disorder and Siculine Syrup (*Kwanashie et. al., 1998a,b, 1999 and Ejiofor et. al., 2007b,* 2008)

My interest in sickle cell anaemia derives partly from its being basically (including in Nigeria), a disease of childhood. Although the sickle cell trait and disease is common in Nigeria, the prevalence, incidence and other basic data relating to its occurrence and management were largely unknown in the northern parts of the country. That was prior to our examination of data available over five years from two weekly sickle cell clinics run by the ABU teaching hospital (ABUTH) Zaria. Of the 6,466 patients sent for haemoglobin genotyping from 1993 to 1997, 63% had normal haemoglobin, 24% were carriers of the sickle cell trait/gene while 13% had the full-blown disorder. While 'labels' are discouraged for ethico-social reasons, this last group may be termed 'sicklers' for

ease of reference in this presentation. The predominant genotype among the sicklers was Hb-SS+F (69.7%), followed by Hb-SS (24.0%); 6.2% and 0.1% of the sicklers being Hb-SC and Hb-SC+F genotypes respectively. No sex difference was found regarding the occurrence of sicklers in the study population. However, the vast majority of the sicklers were infants aged one year or below (40.3%) and two years (29.5%). While it may be argued that the relatively high morbidity and mortality associated with the condition, prevents many of those affected from growing into adolescence and adulthood, the present data may have been skewed upwards having been derived from a hospital diagnostic laboratory. That notwithstanding, these data were similar to reports from the south of Nigeria (Fleming, 1982).

In a related study (based primarily on patients' folders and discussions with doctors and other staff), we sought additional basic data relating to sickle cell anaemia in Nigeria (Kwanashie *et. al.*, 1998b). Age and weight correlations showed a generally retarded growth in children with full blown sickle cell disorder, compared to other children, which difference was seen by the 6th month of age, and could be as high as 18%. The hand-foot syndrome, fever, cough and hepatosplenomegaly (especially hepatomegaly) were the most common signs and symptoms of sickle cell anaemia encountered. Laboratory investigations showed extremely low PCV (average being 24.89%) and haemoglobin (average being 7.64 g/dl) compared to 37-54% and 11-17 g/dl in the normal population.

We were also interested in the drug and non-drug management of sickle cell anaemia in Nigeria and whether or not, this was supported with a sound pharmacological basis (Kwanashie *et. al.*, 1998b). Routine drug therapy encompassed pricipally, malaria prophylaxis with proguanil (100%) and the use of folic acid as haematinic (97%). Other frequently used drugs were chloroquine (42%) for the treatment of malaria; several antibiotics (54%) and paracetamol (25%). Since malaria is the single most important trigger of crises in these patients who also needed exogenous folate for the requied haematopoeisis; there was sound rationale for the pharmacological management of sickle cell anaemia patients, in and out of crises situations, at ABUTH Zaria. Non-drug management measures such as advice on good nutrition, general health care and genetic counselling were routinely given. Transfusion of blood and

blood products was largely avoided primarily to prevent possible infection with hepatitis and HIV. Patients were mostly asked to see their doctors every three months, although appointments scheduling could be as frequent as one week. These non-drug management approaches were also adjudged to be in accordance with good medical practice.

Having provided some background data, my interest was directed at the screening of some of the natural products believed to be useful in Nigeria's folkoloric managemnet of sickle cell anaemia. One of such products, 'Siculine Syrup', which is a composite plant extracts purported to be useful in the prevention and treatment of sickle cell pain crisis, became the subject of one of my MSc student's research and my other independent research. Dr Janet Ejiofor found that siculine (0.625-5.000%) concentration-dependently inhibited sodium metabisulphite-induced sickling in both Hb-AS and Hb-SS red blood cells; but had no effect on already sickled RBCs of either genotype. Furthermore, inhibition of sickling was more pronounced in the Hb-SS genotype than in Hb-AS, with 2.5% siculine giving the optimum inhibition of sickling in both genotypes. Siculine (10 and 100 mg/kg) also exhibited a dose-dependent analgesic effect in BALB/c mice, which effect was lower than that of dipyrone. These antisickling and analgesic effects were statistically significant (P=0.05-0.001) when compared to saline controls; and were probably the pharmacological basis for the extract's purpoted usefulness in sickle cell pain crisis. The data (Ejiofor *et. al.*, 2007b) suggests that while siculine may have a place in the *prevention* of sickle cell crisis, as a result of its ability to inhibit sickling, it may not be so useful in the *treatment* of an established crisis, since it had no effect on the reversal of already sickled RBCs.

Further experiments were carried out to determine the effects if any, of siculine on various muscle preparations (Kwanashie *et. al.*, 1998c and 2009). Siculine (0.2-1.0 μg/ml) like acetylcholine (40-400 ηg/ml) contracted the isolated rat uterus preparation concentration-dependently. Similar effects were observed with the guinea pig ileum and rabbit jejunum (0.4-2.0 μg/ml). In contrast to these effects, contractions due to direct and indirect stimulations of the rat phrenic nerve/diaphragm preparation were relaxed by siculine (0.4-0.8 mg/ml), as did d-tubocurarine (0.8 μg/ml). Again, these

effects were concentration-dependent; and may have possible therapeutic and/or toxicological effects.

Phytochemical screening, antimicrobial and other studies were also carried out on siculine (Ejiofor *et. al.*, 2008). Siculine was shown to contain cardiac glycosides, flavonoids, terpenes and sterols; but not alkaloids, saponins, anthraquinones, tannins, phlobatanins, starch or free reducing sugars. The extract also exhibited antimicrobial activity against *S. aureus* but not against *P. aeruginosa* and *E. coli*. Food intake was not affected by siculine administration which increased water intake in both male and female Wistar rats and resulted in diuretic effect especially in the female.

As part of an on-going exercise to map out the pharmacological profile of siculine, the cardiovascular effects using the isolated guinea pig atria, perfused rabbit heart and cat blood pressure set-ups, were investigated (Kwanashie *et. al.*, 1998c, 1999 and 2009). Siculine, concentration-dependently decreased both the rate and force of contraction of the guinea-pig atria (0.05-5.00 ml) and rabbit heart (0.2-0.8 ml). Siculine (0.1-3.2 ml) also resulted in fall in cat blood pressure in a concentration-dependent manner. These effects were similar to those of, and potentiated by acetylcholine while they were opposite to, and antagonised by epinephrine. The mechanism(s) of these actions of siculine, the possibilities of hypotensive side effects when used in sickle cell crisis, as well as its potential as an antihypertensive agent, remained to be investigated. Because the exact composition of siculine remained unknown to us (despite great efforts); its potential as an antisickling agent and as an antihypertensive, etc, could not be investigated further.

This somewhat abrupt ending to the siculine story is typical of many such pharmacological investigations into ethnomedicines. These can only progress into drug development when key challenges such as protection of indigenous knowledge and intellectual property rights have been adequately addressed. Such challenges and prospects have been well identified/reviewed (e.g. by Busia and Kasilo, 2010; Kwanashie, 2011 and Kwanashie *et. al.* 2012), and are merely awaiting action.

3.6.4 Postpartum Haemorrhage and Other Contributions

Dr Sadiq Uthman, a PhD graduate supervised by me conducted a comparative study of the efficacy of intravenous oxytocin and oral misoprostol tablet in the prevention of postpartum haemorrhage in Maiduguri, Nigeria (Uthman, 2011). As we are still in the process of publishing the findings, I will simply summarise the conclusion in one sentence, thus: Although the two medication approaches were safe and could be interchanged, 600 μg oral misoprostol tablet resulted in better prevention of postpartum haemorrhage than 10 IU intravenous oxytocin (Uthman *et. al.*, 2011). Despite the fact that ethical issues regarding possible misuse of misoprostol for criminal abortions if made widely available, is still being debated, the potential for saving lives, and meeting millennium development goal No. 5 is obvious. Similarly, Dr B.A.Z. Chedi had evaluated drug use and medication errors in paediatric patients in Kano State (Chedi, 2012) - findings of which will make for rational drug use in children. Again, our findings are not yet fully in the public domain, and hence cannot be shared at this forum.

Then, there is the issue of malnutrition, to which children and women are particularly vulnerable. From her MSc research project, the very first postgraduate student supervised by me (Dr Hafsat Shittu), we had reported that the combined effects of malnutrition (specifically protein-energy malnutrition) and cimetidine on hepatic drug oxidation is synergistic inhibition to the greater detriment of female and young rats (Shittu *et. al.*, 1994a,b). Similar studies on the effect of nevirapine on combined malnutrition and immunosuppression in Wistar rats have just been concluded by Mrs Hauwa Faruk, another MSc student of mine, who is awaiting external examination.

Other studies carried out by my group testing out natural products on uterine contractility have potential for informing better drug use during pregnancy and labour. These include medicinal plants like *Khaya senegalensis* (Olurishie *et. al.*, 2006) and minerals like the food additive, natron (aka *kanwa*, Alawa *et. al.*, 2010). In addition, I should mention also a number of other research and reports that may not directly be restricted to women, but by their very nature, may find special applications in females - e.g. measurements of toxic formaldehyde levels in cosmetics (Ugye *et.*

al., 2011), pharmacological and non-pharmacological management of obesity (Kwanashie, 2000a) and significance/implications of drug abuse by women (Kwanashie, 2000b).

3.6.5 Contributions of the Malaria, HIV/AIDS, Sickle Cell Disorder and Postpartum Haemorrhage Studies to Recalling Therapeutic Exiles

These various studies on malaria, HIV/AIDS, sickle cell disorder, postpartum haemorrhage and medication errors in children, highlighted above are directly poised to recalling women and children from therapeutic exile (having met several of the criteria outlined in 3.1), and hence need no further elaboration.

3.7 Contributions Through Teaching and Community Service

The contributions outlined here may relate to recalling women and children from exiles other than therapeutic exiles. However, given the WHO's extended definition of health to include 'mental and social well-being', these like those in Chapter Four do qualify for inclusion in this discourse!

3.7.1 300 Level Lecture on Drug Treatment of Anaemia

Forum: Undergraduate pharmacology class

Duration: Two hours contact time annually

Approximate Reach: Over 100 female students every year

Perinatal Period: Women and children across the perinatal period

Contribution: Female students are encouraged to ensure that they and their children eat sufficient highly nutritious foods rich in (protein), vitamins (like folic acid) and minerals (like iron) required for production of red blood cells such as green leafy vegetables, plantain, meats, liver. This they can and should do during food preparation in the kitchen, if it is culturally unacceptable for them to eat the best and enough portions of such foods as meat at the dining table. Students are also requested to pass the message on.

3.7.2 Community Service to the Blind and Visually Challenged

Forum: Hope for the Blind

Duration: Two hours a week at intervals between 1992 and 1997

Approximate Reach: Difficult to estimate, but could be hundreds of blind or visually challenged students

Perinatal Period: Children mostly

Contribution: I was reading textbooks into audio media in a recording studio. These were then reproduced and distributed to secondary school students who were blind or visually challenged across the nation.

3.7.3 Community Service to Improve Teaching

Forum: Eduwatch Workshop for Teachers in Yaba, Lagos

Duration: 2 days (17^{th}-18^{th} February 2010)

Approximate Reach: About 40 school teachers

Perinatal Period: Women directly, children indirectly

Contribution: I was co-organiser and co-facilitator of a workshop on *Developing and Strengthening Reading and Writing Skills Across the Curriculum.*

3.7.4 Community Service to Professional Society

Forum: West African Society for Pharmacology , (WASP) programmes at Exco and general assembly levels
Duration: Approximately quarterly, from 2011 to 2013

Approximate Reach: Varies, potential beneficiaries are in tens (and is continuing)

Perinatal Period: Women and children

Contribution: As president, with the cooperation of WASP Exco, I initiated and promoted provision of crèche facilities and nannies at WASP programmes, paid for, by the society. This was borne out of the belief I held and propagated that no woman should stay away from attending a conference or other academic programme, just because she's a woman. Many women benefitted and attended WASP meetings and workshops with their young children as a result of this policy/programme, earning the lecturer the nickname - 'Grandma Prof'!

3.7.5 Community Service to Gender-based Association

Forum: ABU Chapter of National Association of Women Academics (NAWACS-ABU)

Duration: Continually from 1999 to 2002

Approximate Reach: Over 100 women academics
Perinatal Period: Women

Contribution: As president and working with NAWACS-ABU Exco and other members, I initiated and promoted the career advancement programme, code-named *At Least One!* This became a greeting and response amongst members, and is intended to remind each woman academic to aim, in the course of every session, to:

- present *at least one* seminar
- attend *at least one* conference, to which she should contribute *at least one* paper
- publish *at least one* article in a reputable peer-reviewed journal in their discipline
- be part of *at least one* research grant in some capacity/level such as proposal writing, grant administration or retirement, etc.

Although, it is difficult to assess the overall benefits of the *At Least One!* programme, women academics in ABU themselves attest frequently to having been gingered by it.

In addition, trainings were organised for NAWACS-ABU members on proposal writing, paper presentation and paper

publication to give the women the requisite skills they needed for the *'At Least One!'* programme to work. The setting up of a post-workshop monitoring group (PWMG) in which senior members assisted 1 to 3 junior ones (each within their disciplines), became the beginning of a semi-formal mentorship scheme. This scheme I believe, contributed in some way to the advancement of the careers of women academics in Ahmadu Bello University and to their job satisfaction in the years since.

From two female professors at the initiation of the *At Least One!* programme, now there are tens of female professors in the university (over a period of 15 years). It is possible that this programme and the training workshop alluded to above, contributed to the accelerated career advancement among these women academics.

3.7.6 Community Service to the University

Forum: ABU Gender Studies Group, Etc

Duration: From 2002 to 2006

Approximate Reach: Difficult to estimate
Perinatal Period: Female students and Women

Contribution: As part of a group of six comprising of Prof (Mrs) Doris Bozimo, Dr Clara Ejembi, Prof (Mrs) Juliana Okpapi, Prof (Mrs) Felicia Adeyanju and Prof Emmanuel Gyong (the only male member of the group), we undertook a situation analysis of gender equity in ABU as at 2003 (Bozimo *et. al.*, 2003). This work contributed to the university securing the Carnegie Corporation of New York grant which included bursary awards to female postgraduate students as part strategy to bridge gender inequality. A follow-up to this showed some measure of progress in ABU's attempt at gender equity (Kwanashie *et. al.*, 2004; Kwanashie and Aliyu, 2006).

3.8 Reference to Other Contributions

There are many other contributions which I have made towards rational drug use in women and children, and towards their

general emancipation, that space and time does not permit me to present at this lecture. What I have done at this forum is to show sample contributions from my research mainly, but also from my teaching and community service that directly and indirectly work towards recalling women and children from exile. In the next and final chapter, through a clarion call for action, I hope to demonstrate that there's room for everyone to be pro active in recalling women and children from all sorts of exiles (therapeutic and otherwise), to the benefit of everyone and society.

Chapter Four

A Clarion Call For All

4.1 The MDGs, Women, Children and the Perinatal Period

This chapter emphasises other forms of exiles to which women and children are subjected, including but not restricted to the following: restricted access to education, not being given their rightful place in society, being frequently overworked, not being appreciated for their worth and work, bearing the brunt of wars/conflicts/famine, etc. I believe that given WHO (1948) inclusive definition of 'Health' rendered below (and which has not been amended since 1948), all of the above may be regarded as 'therapeutic exiling' by extension[78].

> Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.
> - *World Health Organisation, 7th April 1948.*

The millennium development goals (MDGs) appear to be a reasonably good place to start this final part of the discourse in which it is argued that recalling women from therapeutic exiles is, to use Shirkey's words 'everybody's business' (Shirkey, 1968b, 1970 and 2006). Three of the keywords in the lecture content thus far, namely: 'malaria', 'HIV/AIDS' and the 'perinatal period' are linked together by the MDGs. The MDGs were established in 2001 by the United Nations (UN). The overall aim was to create a framework for implementation of the Millennium Declaration which had been adopted the year before, by 189 countries (including Nigeria), with the specific objectives of reducing poverty globally, and creating a climate for sustainable development. The Millennium Declaration states:

---

[78] Not included in this discourse (though equally important) are unequal pay for women doing same jobs as men in some parts of the world, restricted female participation in politics, leadership and inheritance, domestic violence, human / sex trafficking, etc.

> We will spare no effort to free our fellow *men, women and children* from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected. We are committed to making the right to development a reality for everyone and to freeing the entire human race from want.
>
> *- UN Millennium Declaration, UN A/Res/55/2, 2000 (italicised emphasis, mine).*

It is noteworthy here too, that men, women and in this instance, children are mentioned in one and the same breath.

There are 8 MDGs altogether, with 18 specific targets and 48 indicators, all of which set a most ambitious agenda for greatly improving the quality of human life by 2015. These goals which have since become the international gold standards for measuring development progress especially as they relate to women and children are shown in Table 9. From the table, it is clear that the MDGs are largely about women and children; the girl-child in particular. Furthermore, of the many diseases plaguing the world, only HIV/AIDS and malaria, are mentioned specifically in the MDGs, diseases to which pregnant women, newborn babies and under-5 children (again, the girl-child in particular), are mostly susceptible. Since by definition, the perinatal period applies to that period of life, just before, during and shortly after birth (Stern, 1975), one may say that the MDGs are largely about the perinatal period. In my own small way, I have been a champion of the MDGs as an extension of my goal to recall therapeutic exiles (e.g. Kwanashie, 2007, 2010, 2012; Kwanashie and Alti-Mu'azu, 2009 and Kwanashie *et. al.*, 2008). Again, it is informative that the official event marking the 2014 International Women's Day reflected on the achievements and challenges encountered worldwide in addressing the needs and priorities of women and girls in implementation of the MDGs, and in the formulation of the post-2015 development agenda.

4.2 Generalised and Pervasive Gender Discrimination

The lecturer hypothesis that therapeutic exiling and therapeutic smuggling is a natural outcome of the gender discrimination so pervasive in society, almost from the very dawn of

age. Despite the absence of scriptural, evolutionary, scientific, and other bases, gender remains a development differential in which women are at a disadvantage (United Nations, 1994a,b,c). *Gender* has long been recognized as a social construct rather than a biological or physiological one. Since 1975 – International Women's Year – the UN began the tradition of recognising March 8 as International Women's Day. Incidentally, the subject of this inaugural lecture is in line with the theme of the 2014 internationalwomensday.com global hub, namely: "Inspiring Change" – which is intended to "celebrate the social, political and economic achievements of women, while focussing world attention on areas requiring further action". The lecturer has satirically exposed these sentiments routinely, in and outside of her professional discourse, of which four examples (with the fourth concerning children) are given below:

i. Discordant Evolution
ii. Of Double Helical Structures...
iii. Working Wife and Mother
iv. What Prize?

Table 9: MDGs and Their Primary Targets

Goal No.	MDG	Primary Target Group			Remarks
		Men	Women	Children	
1	Eradicate extreme hunger and poverty	√	√√	√√ (girls esp.)	Women and children (particularly girls) are *the poorest of the poor.*
2	Achieve universal primary education			√ (girls esp.)	Girl-child is particularly disadvantaged.
3	Promote gender equality and empower women		√	√ (girls)	Gender disparity outcomes affect women and girls on several fronts.
4	Reduce child mortality			√	Female children are less likely to receive healthcare.
5	Improve maternal health		√	√ (girls)	Early marriage / motherhood is detrimental in girls.
6	Combat HIV/AIDS, malaria and other diseases	√	√√	√√	Pregnant women and children < 5 are especially vulnerable.
7	Ensure environmental sustainability	√	√	√	
8	*Develop a global* partnership for development	√	√	√	
	TOTAL SCORE	**4**	**8**	**10 (girls, 14)**	

√ Score, not part of the MDGs are assigned by this lecturer.
Double score (√√) emphasises magnitude of target, making the MDGs (in the opinion of the lecturer), much ado about men, more so about women / children, and much more about the girl-child.

4.2.1 Discordant Evolution

This piece is the combination of a newspaper cartoon and a poem. The *Dayton Daily News* is an American newspaper while the cartoonist, Mike Peters is presumably MALE (although in today's world, one never can be certain!). The poem was written by this lecturer to further drive home Peter's message of an unfair gender disparity against women.

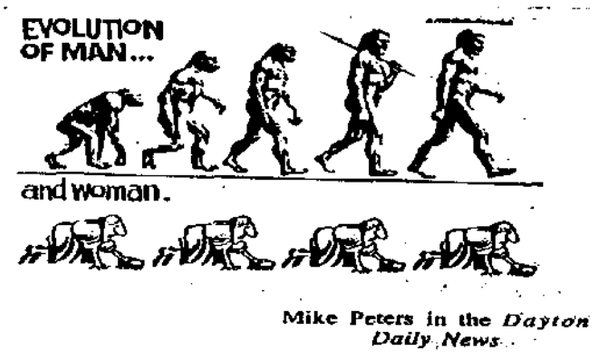


Figure 5: Discordant Evolution

Discordant Evolution

Whether you believe
In it or not
The scientific theory
Of evolution, holds
That *Homo sapiens* was
Once upon a time
Less than even an ape.

From this *lessness*
Man has evolved
To walk tall and upright
To dominate the world
And woman
Who by
The socio-cultural theory
Of evolution, remains'
Less than even an ape.

- © HelenOK, 1992.

4.2.2 of Double Helical Structures...

The second example is a poem (see below) which celebrates women for the work they do, including the so-called menial tasks like drawing water, fetching firewood, etc, that are often unacknowledged, unappreciated and unrewarded.

Of Double Helical Structures, Nobel Prize Winners: Sung and Unsung[79]

Long before '53, James Watson and Francis Crick
Nene held the secret of life in her hands!
Ropes, she herself had constructed
(Not just discovered)
From double strands of rush
Twined to form a helical structure
Each depending on
And strengthening the other.
Ropes, she dutifully employed
Drawing water, bundling firewood, etcetera
In service of mankind
Within her family and community.

Alas! If she had but owned a lab!
And understood base pairs, nucleotide sequences ...
Detailing her knowledge to *Nature* or *Science* or *JBC*[80]
My grandma could have won
The Nobel Prize ...
For she frequently made; and held daily
From childhood through adulthood
A double helical structure
In one; nay, two; nay, several tasks

---

[79] Dedicated to my paternal grandmother, *Nene (this name translates to 'grandmother' in my native Urhobo)*, the poem was originally written as the statement to an artwork meant for KINESIS 4 - an Exhibition of Women Art and Science which held in Zaria, Nigeria, from 1st to 7th December 2003. The theme of the Exhibition was *Molecular Construction*, chosen to commemorate the 50th anniversary of the discovery in 1953, of the genetic code (double helical structure of DNA) by James Watson and Francis Crick, for which they were awarded the Nobel Prize.

[80] *Nature, Science, JBC (Journal of Biological Chemistry)* are top journals for prime publications in science, biochemistry, pharmacology, etc.

As she ministered constantly to the human race.

As the world celebrates
50th year discovery of DNA structure
And the phenomenal advances derived therefrom
Recombinant DNA. Human Genome Project, others ...
Shouldn't we also salute
All who have known other double helical structures
As symbols of sacrificial service?

Though without scientific understanding
Hush. Woman! typified by hardworking *Nene*
Hush. Woman! *you too are a noble prized winner*!

© HelenOK[81], 2003

4.2.3 Working Wife and Mother

The third example (Figure 6) is replication of a drawing of the Fulani Milk Maid, as a salute to all working wives and mothers.

[81] As a pharmacologist with biochemistry background, Kwanashie is naturally fascinated by all that the knowledge of DNA has bestowed on mankind, particularly since the last two decades of the last millennium. As a child, she also had enjoyed making and using handicraft ropes, some of which were strikingly similar to the double helical structure of DNA and which when dry and cut, unravels in much the same manner into single complementary strands ...

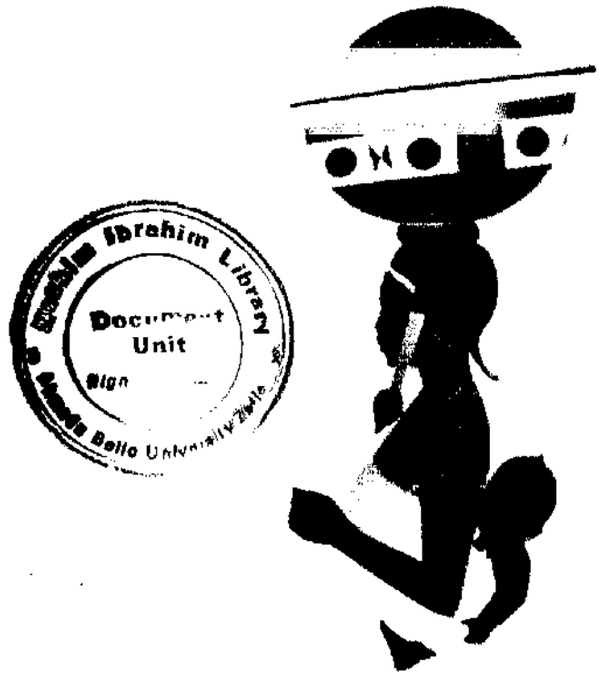

Ibrahim Library
Document Unit
Sign
Bello University

Figure 6: Fulani Woman at Work with Her Child
(**Source:** Baraka Press, Kaduna, Nigeria)

The Fulanis are nomadic cattle rearers and constitute a major ethnic group in Nigeria (and across parts of West Africa). Their womenfolk are rugged; effortlessly bearing the strains of frequent movements while selling fresh milk, yoghurt and other dairy produce (as in the picture above), even as they care for their families and their homes. A Fulani woman like other women in Nigeria and like their counterparts the world over, fulfil multiple roles of being wife, homemaker, mother, worker, food and healthcare provider, as well as being involved in community service. Many fulfil each of these roles to varying degrees, excelling in some areas, but not in others... Still this picture is a tribute to the many women worldwide *working both in the home, and out of it!* It is also to showcase that therapeutic exiles are vital contributors to society, and deserve to be recalled.

4.2.4 What Prize?

In the fourth example (Figure 7), I had written a piece, titled: 'What Prize?' to question the attitude of the winner of the 1994 Pulitzer photo prize, and I present it here to question the attitudes of all of us who walk away from a need such as helping a dying child, or recalling women and children from therapeutic and other exiles.



Figure 7: The 1994 Pulitzer Prize Winning Photo
(Source: One of the weekly newsmagazines in Nigeria)

The comment beneath this photo in the newsmagazine was:

This PHOTO is the "Pulitzer prize" winning photo taken in 1994 during the Sudan famine. The picture depicts a famine-stricken child crawling towards a United Nations food camp, located a kilometer away.
The vulture is waiting for the child to die so that it can eat it. This picture shocked the whole world. No one knows what happened to the child, including the photographer Kevin Carter who left the place as soon as the photograph was taken. Three months later he committed suicide due to depression.

In response to the photo and comment, I had written this piece:

What Prize?

Perhaps, if Kevin Carter had helped that poor child get to the food camp, he may not have gone into depression and committed suicide.

What do you do when confronted with a need or evil? Snap a photo and walk away?

- © HelenOK, 2006.

4.3 Negative Discrimination, Positive Discrimination And Roles For Everyone

Starting from age-long negative discrimination against women, the decade for women (1975-1985) saw an increase in efforts to assess the degree of gender inequity and evolve strategies to redress it. Central to this, was the 1979 Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) which established wide-ranging and explicit principles of gender equality in the political, social, cultural, legal, economic and civil spheres. As previously argued, this partly informed majority of the MDGs goals, targets and indicators. Part of the redress of gender inequality has had to do with positive discrimination or affirmative action in favour of women, and which the lecturer endorses as a good strategy in the short run (despite its limitations and disadvantages). This has led to some significant changes, socially, biomedically and clinically. Only last year (2013), there was the promulgation that the heir to the British throne is now the first born, regardless of whether the individual is male or female. For animal toxicity testings, females are increasingly becoming the preferred sex to use, simply because they are more susceptible to drug effects than their male counterparts. Even in the clinical setting, some sex differences in drug effects are now being more researched. Recently, for example, Darpo *et. al.* (2014) using a therapeutic dose of sotalol found that the change in QTc interval was steeper in women than in men which possibly explains why women may be more susceptible to drug-induced arrhythmias. Some of the world's renown professional societies practice some form of positive gender discrimination e.g. via the Women in Pharmacology programme of the British Pharmacological Society. Another example is the setting up of Gender Equality in Science grants by the Biochemical Society, and for which even non-members may apply. Thus, one is optimistic that in both social and non-social contexts (e.g. basic and clinical pharmacological research), regarding gender inequality, as the saying goes, the future is bright - the future is orange; including for *therapeutic exiles*.

4.3.1 Roles for the Biomedical Researcher

The potential roles for biomedical researchers and scientists in recalling women and children from therapeutic exile are many and varied. Obviously, this includes research and documentation at both basic and clinical levels as earlier defined (Kwanashie *et. al.*, 1989). While this should not be exclusive to female biomedical researchers, the challenge I think, should appeal specially to *women biomedical scientists and clinicians*. Rebecca Anderson's recently published book, *Nevirapine and the Quest to End Pediatric AIDS* (Anderson, 2013), is an example of one way to fulfil this role. Incidentally, she had worked for 25 years in pharmaceutical research and development prior to her becoming a medical writer. Education and advocacy is one other role, and with all due modesty, this lecturer's constant advocacy to recall therapeutic exiles is one way to fulfil this role. This also was the role of the paediatrician, H.C. Shirkey who from the 1960s and several decades, led the campaign to make provision for therapeutically orphaned children. There are lots more roles... and together, fulfilling those roles speak for women and children.

4.3.2 Roles for Everyone

In a plan of action to meet the HIV prevention needs of Africans living in England, Dodds *et. al.* (2008) emphasised the need to combine knowledge, will and power in order to effect changes. No less is required in recalling women and children from therapeutic and other exiles. "People may understand the importance of a particular behavior (knowledge), and they may want to undertake it (will) but lack the actual capacity (power) to do so." The knowledge and the will are succinctly captured in UN Secretary-General Ban Ki-moon statement to mark this year's International Women's Day with the theme: *Equality for women is progress for all.* He had said:

> "This International Women's Day, we are highlighting the importance of achieving equality for women and girls not simply because it is a matter of fairness and fundamental human rights, but because progress in so many other areas depends on it.
> Countries with more gender equality have better economic growth. Companies with more women leaders perform better. Peace agreements that include women are more durable. Parliaments

> with more women enact more legislation on key social issues such as health, education, anti-discrimination and child support.
> The evidence is clear: equality for women means progress for all.
> This simple truth must be central as we work to accelerate progress towards the Millennium Development Goals by next year's deadline and craft an agenda for the years beyond 2015."
> - *UN Secretary-General, Ban Ki-moon, 8th March 2014.*

I like to think that presently, we have the knowledge... hopefully, we will develop the will... but always the power is in our hearts and our hands, as we keep as frontlet, the following quote.

> Have the end in mind and everyday make sure you are working towards it.
>
> - *Ryan Alus.*

Ladies and gentlemen, let's just do it!

4.3.3 *Institution* of Prizes for Best Female Students in Pharmacology

I wish to use this occasion of the presentation of my inaugural lecture to institute two annual prizes in the Department of Pharmacology and Therapeutics. The prizes are to be awarded to the best graduating female students in Pharmacology amongst:

- Pharmacy (BPharm) graduands, Faculty of Pharmaceutical Sciences, and
- Medical (MBBS) graduands, Faculty of Medicine.

At an appropriate time in future, I hope to institute similar prizes at MSc and PhD levels. The prizes are meant to stimulate female students' interest in pharmacology and encourage them to want to pursue pharmacological research in general, and hopefully, those research that will be particularly beneficial to women and children.

4.4 A Mummy-General's Final Word

At the start of this lecture, I made reference to my being nicknamed 'General', and to being called 'Mummy'. It seems fitting, that I end it on a similar note.

This 'General' wants to believe that for the onerous cause of recalling women and children from therapeutic and other exiles, she has been one small voice in the past, and today. I must add the fact though, that she prefers to be perceived, known and addressed by the more mundane title of 'Teacher', rather than 'General'! As for

being called 'Mummy' rather than 'Prof(essor)', I can find an acceptance and explanation, again in the words of the founding chancellor of our university, Sir Ahmadu Bello, who insisted that ours must be a home-grown university, in the following words:

> *... our character must reflect the needs, the traditions, the social and intellectual heritage of the land in which we live.* Inevitably in a country developing as fast as ours, we must call on outside help. That we have received in generous measure. But in seeking help from outside it is not our intention to copy a standard pattern of University from the United Kingdom, from the Commonwealth, or from the United States of America. *We must develop our own pattern to suit our present background and our needs. Our University must grow out of our own soil. We shall be truly Nigerian institution and not the mirror image of some alien body.*
> - *Sir Ahmadu Bello, in Our Charter, 23rd November 1963. (italicised emphasis, mine).*

Fifty years on, and still so remarkably correct! I interpret this to mean that in Nigeria, students don't necessarily just see their lecturers as professionals, but rather as someone more holistic... to the point of meeting their other (non-academic) positive needs (yes, even primordial ones). I must admit that the idea of being perceived as a 'Mummy-Professor' or even 'Mummy-Teacher' is tonnes more attractive, than being seen as a 'Mummy-General'! As it turns out, I understand that the in-word now is 'educator' rather than 'teacher'... so perhaps, who knows, I may even wind up eventually as a 'Mummy-Educator' (alias Grandma-Prof)!

Mr Vice-chancellor Sir, Ladies and Gentlemen, in my continuing research, documentation and advocacy to recall women and children from therapeutic and other exiles, I rest my case (for now).

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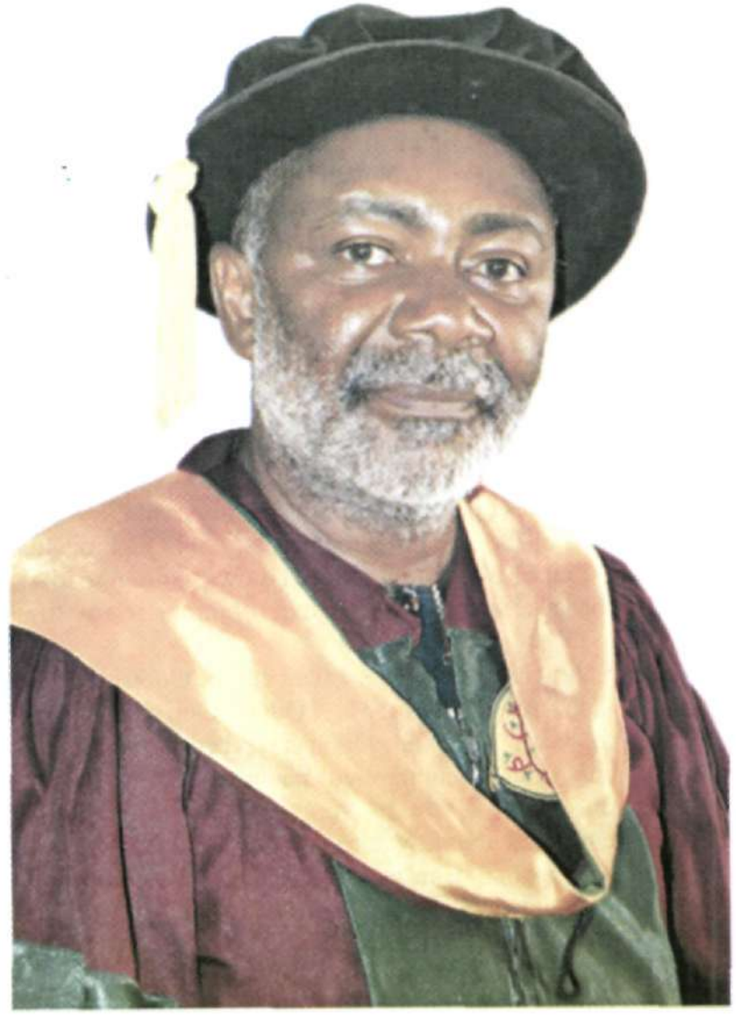
Nigerian Local Government System: Decentralization and Democracy for Development or Decentralization, Democracy and Development

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Chapter Six

Nigerian Local Government System: Decentralization and Democracy for Development or Decentralization, Democracy and Development



Adejo Odoh
Professor of Local Government and Development Studies

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The Journey to Professorship has its remote and immediate engineering. The beginning can be said to be remote now because it has been laden with history. The truth is that the man Adejo Odoh, became what he is today principally through God's will or design, and the goodwill and amazement of men and the social energy in him. In all these, I give thanks to the Almighty.

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I want to use this medium to remember all my secondary school classmates of the class of 1970 at Ochaja Secondary School. The smallest and youngest boy self actualised ten years ago. Not surprising, is it. Yes it is now common knowledge. I relive our experiences with relish and may God guide each and every one of you as you journey through your old age.

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Once again to God be the glory.

Mr. Vice Chancellor, all other protocols observed, I thank you for your patience, and kind attention.

Preamble

My deep appreciation to my God and my warm and heartfelt greetings to this great Assembly.

Prior to this occasion, Mr. Chairman, I had tried to create an opportunity to present a public lecture on the "Image of Local Government in Nigeria," to a large forum of people of diverse backgrounds. This opportunity presents itself to do something similar except that this occasion carries its own tradition different from a public lecture. That forum still needs to be created for greater rubbing of minds, given the level of public knowledge and attitude towards local government (LG).

The topic under consideration has a way of allowing us decide on the issue of image at the end of the presentation. It is a pre-requisite for undertaking an image building project on Local Governments in Nigeria.

I want to appreciate the authorities of Ahmadu Bello University for providing me this opportunity to account for my journey towards professorship and the contributions I had made to knowledge in this subject area. This great University awarded me a B.Sc and M.Sc. in Political Science, MPA Local Government and Ph.D Public Administration. I am therefore a home grown scholar in terms of degrees obtained.

My first contact with Local Government Studies was when I completed my M.Sc. Political Science, in 1982. The then Director of the Institute of Administration Prof. A.Y. Aliyu encouraged me to join the Department. Then I had strong reservations about Local Government (both as a discipline and as a profession). Even while pursuing my first degree, my inclination was towards International Relations and so, I never offered any courses on Local Government. On completion of my first degree, I was appointed External Affairs Officer, Grade 8 in the Ministry of External Affairs, but I had to turn that down because of my flair for academics which made me prefer to do the Masters Programme in Political Science. After the 2 years Masters Programme, on enquiry, the Ministry of External Affairs confirmed that my job in the Ministry was still available. Despite this, I still chose to take the appointment with the Department of Local Government Studies, A.B.U. Zaria. My consolation was that

being a Political Scientist, Local Government Administration, which is itself technically part of Political Science, was not going to be a difficult nut to crack.

The first challenge on the job and in the area was on attitude. People always felt and particularly then, that both lecturers and students of the Department were Native Authority personnel, connoting some backyard classification. The problem had to be made to turn into a challenge and people needed to know that being in Local Government should not carry a demeaning connotation. On closer study of the situation, I discovered that rather it was people who were ignorant and that they actually required the sympathy of those of us in the system.

My relevance in the Department and the Profession stemmed from this orientation. The challenge was that the discipline of Local Government needed to be elevated and its image improved to prevent misconceptions by both 'insiders' and 'outsiders'.

Choosing an area to work on became the next concern. Local Government is an agent of development, but it has to be effective and efficient in its administration for it to be relevant as a development agent. The study of Local Government system must shift from the Institutional-Process perspective to a mobilizational-development oriented one. Thus, it became imperative to study both, and shift emphasis to the more result oriented perspective. This is why in my earlier writings, the focus was on institutional growth on administration and service delivery. Very importantly variables such as personnel and institutional capacity building, financial devolution and development preoccupied my concern. My MPA (LG) thesis for example was on "Oil Revenue and its impact on Local Government Finances in Nigeria". Later on, I began to be bothered by the failing performance of LG despite oil revenue and the series of Local Government Reforms carried out by both the Civilian and especially the Military administration. That launched me into writing a PhD Dissertation on "Autonomy as a Principle of Local Government Administration in Nigeria." The Dissertation opened up a vista of issues related to Decentralization. My worry was that LGs experienced varying levels of decentralisation but there had been no significant effect on development or service delivery at the community level, irrespective of whether the milieu was a democratic or non-democratic one. The theory had been that

devolution and deconcentration, both variants of decentralization had varying degrees of impact on development but in the Nigerian case, that trend was lacking. It was the same story irrespective of the variant. This was why most of my writings since then attempted to query the situation and how LGAs can be empowered to respond to development challenges at the grassroots level given its legal, political and administrative frameworks. It is in this direction also that towards the end of this lecture, the application of a current paradigm on local government and development is advocated.

Mr. Chairman, permit me to add here that it has not been all research and publications but that on my part, I had as Head of Department, spearheaded the introduction of the first degree programme in Local Government and Development Studies in 2004, and in 2014 my efforts at preparing the proposals for the newly introduced M.Sc. Policy and Development Studies and M. Policy and Development Studies (Part time) were rewarded. Thus, the status and image of the Department had been enhanced through these two academic programmes. Hitherto the Department was noted basically for Diploma Courses, even though offering Masters of Public Administration (LG) and Ph.D Local Government at that time. Teaching has not been left behind as I have always managed to give my best to ensure that students get the best in terms of quality of teaching and in character building. We had always wanted our students to project the image of the Department to help reduce the misconceptions about LG. It is a task that continually needs to be done. I also thank God that today, I am one of the converts who believe in Local Government as an academic discipline and as a profession.

My task in all these endeavours could not have been possible without the support and cooperation of present and past and outgone colleagues of the Department. Professor Halidu I. Abubakar has been an outstanding senior colleague.

With this preamble, I seek the indulgence of the Chairman to proceed with my lecture titled "Nigerian Local Government System: Decentralization and Democracy for Development! or Decentralization, Democracy and Development; the first of these series from the Department.

1.0 Introduction

Decolonization and political independence cumulatively put enormous pressure on third world countries (including Nigeria) to hasten the process of development of these countries. This is against the background of colonial political, economic, social and even cultural exploitation of the territories, and the fact that the symbolism of independence as a messianic harbinger of better things to come enveloped the thinking and expectations of the people of the territories. Independence was synonymous with social change and rapid development of the erstwhile territories. This automatically translated into the agenda of governments and the need to devise appropriate strategies to bring about such social change to fulfil great expectations.

In reaction to this, the 'emergent' countries resorted to the idea of development planning where administrative and sectoral issues were systematically identified and resourced at both national and regional levels. A corollary of this was the 'strengthening' of the Native Authority system at the Regional level to hasten such development at that level. The cumulative effect of these was expected to be a fast growing economy, a stable polity, a social system that promoted social justice and equity, improved literacy levels, improved modern health care system and agriculture and rural development. In fact in Nigeria, the Third National Development Plan, representatively epitomised these lofty goals of the state (for its citizens) as follows:

i. A united strong and self reliant nation;
ii. A great and dynamic economy;
iii. A just and egalitarian society;
iv. A land of bright and full opportunities for all its citizens;
v. A free and democratic society. (National Planning Office, 1972)

Resources needed to be deployed as quickly as possible under the federal arrangement to facilitate the achievements of these in a planned manner. Part of the vehicle for facilitating such deployment at the rural and community levels were the Native Authorities(NA) later Local Authorities which later transformed into Local Governments. That is why plans were made concurrently by the National, Regional/State and Local Governments each over its

functional areas of jurisdiction and based on its resource scope and constraints.

The story of politics and development since independence has been a story of power sharing, adequate to support development (according to the philosophy of the political elites/policy makers) both at federal and regional levels. The ability of the lower tiers of government to provide services from thence became tied to the level to which power and resources were transferred to these tiers, vis a vis the scope and weight of their responsibilities. This in technical terms is referred to as decentralisation. Local Government (LG) itself is seen as a decentralization and the ability of LG to deliver services is predicated on the level or degree of decentralization it enjoys. Decentralization has become a major framework within which to study the LG system, its behaviour, its functionality and its outputs and outcomes.

It is within this tradition and framework that I have laboriously sought to understand the utility and relevance of the Nigerian local government system among others, over the years. This framework together with its democratic derivative is important for any meaningful analysis of local government as far as the ultimate aim of that institution is concerned.

For a proper understanding of this lecture, there is need to undertake some conceptual clarifications, from studies to show that there is a relationship between the level of decentralization and service delivery, including the catalytic or mitigatory role of democracy. This will also facilitate the understanding of my contribution to the development of this perspective over the years. The second part will then address the Nigerian situation over the years. Part three focuses on my own contributions to the subject matter over the years while Part four provides an altertnative.

1.1 Conceptual Clarifications and Relationships

Definition of Local Government

Local government is defined as

> a sub unit of government controlled by a Local Council which is authorised by the Central government to pass ordinances having a local application, levy local taxes and exact labour and, within limits specified the central

> government, vary centrally decide policy in applying it. (Maddick, 1963)

The United Nations (Office of Public Administration) defined local government as

> a political subdivision of a nation or (in a federal system state, which is constituted by law and has substantial control over local affairs including the powers to impose taxes or exert labour for prescribed purposes (cited in Ola, 1984 : 7).

Within the context of Nigeria, the 1976 Local Government reform defined LG as:

> Government at the local level exercised through representative councils established by law to exercise specific powers within defined areas Federal Government of Nigeria (FGN), 1977).

These definitions regard LG as a form of decentralization exhibiting the following characteristics:

i. a subordinate system of government
ii. legal or constitutional powers
iii. control over local affairs and can take action decisions
iv. mobilise resources – labour financial and material
v. representative council (elected or selected as the case may be).
vi. makes laws, policies and implement them.
vii. territoriality

Most LGs, whether in Unitary or Federal Systems share a lot of its characteristics. The major difference is the level of control or autonomy imposed or allowed in running the system. This takes us to the issue of decentralization.

The three concepts of decentralization, democracy and development require some definition and explanation to provide some take off point.

Henry Maddick (1963) popularised these three concepts of decentralisation, democracy and development in an attempt to provide the framework for analysing the place of local government and its workings and performance. According to him, the concept of decentralization refers to "the transfer of government functions to both agents and units of government in a given country." Even though this definition looks straight forward, Maddick did not hesitate to point out that the process of decentralisation involves the process of deconcentration and devolution. While deconcentration refers to "the delegation of authority adequate for discharge of specified functions to staff of central departments who are situated outside the headquarters", devolution on the other hand, is the "legal conferring of powers to discharge specified on residual functions upon formally constituted local authorities".

A close look at this definition suggests that deconcentration is about field offices or agencies of central governments while devolution involves local authorities that are formally constituted. The legal, constitutional and democratic implications of devolution are not lacking in deconcentration. By extension, these definitions provide the basis for hypothesizing that local governments that experience devolution are more likely to perform (i.e. discharge their responsibilities) than those that experience deconcentration. This statement has implication for understanding LGs as decentralized political and administrative entities in Nigeria. This study is pursuing this lead as the lecture progresses. One other implication of these components of decentralization is that local government can operate as a deconcentration or as a devolution. Deconcentration gravitates towards centralization and control of government functions. Devolution on the other hand, indicates a lessening of control or properly referred to as autonomy, especially as it is mitigated by the democratic base of local government. So, the scope of decentralization involves control and autonomy. The hypothesis still operates the same way thus: LGs that experience autonomy, function and perform better than those that are subjected to control. Normally control refers to greater interferences from central or regional governments while autonomy refers to greater freedom from such control – its ability to exercise control over its decision making process and its resources.

We have however discovered that this hypothesis can only remain intelligible if it is properly contextualised. The unitary systems that have strong flair for centralization tend to run deconcentrated governments (with strong influences on their LGs) while federal systems provide better devolution arrangements and hence are supposed to facilitate more functional and development oriented local governments. This we have found out is more applicable in Less Developed Countries (LDCs) or the Third World. Such a postulation does not hold sway in advanced polities because rather than functionality and productivity depending on the degree of powers decentralized, the economic structure and status of these societies coupled with the quality of their social capital and level of political and administrative organisation would neutralise such postulation. Indeed between France and Britain and China on the one hand (unitary systems) and the United States of America, Germany and Australia (federal systems) local governments are in a position and indeed have shown great results in management, institution building, service delivery (development). On the other hand, between Nigeria that is expressly federal and Tanzania that is unitary, it has been the same story in terms of management, democratization and development. The varying systems have not affected the level of decentralization and development (Odoh 1985). This is a paradox. This is the reason why we caption this lecture as "Decentralization and Development or Decentralization for Development". What obtains in the advanced polities is case of decentralization for development while what obtains in the LDCs is decentralization and development. What ought to have happened to Nigerian LG System under the federal system is decentralization for development while other LDC centralizing countries ought to have been decentralization and development. The federal system has in no way favoured the Nigerian situation with all its theoretical niceties of guaranteeing LGs as third tier with powers, functions and resources allocated and safeguarded. Decentralization and development is a degeneration of devolution into deconcentration while decentralization for development is a functional devolution that is results-based and development oriented. The bottom line here is that in the Nigerian setting, autonomy is a myth, not a reality.

Some contemporary and more recent definitions of decentralization would be briefly presented here to add value to the

archival definition by Maddick and for a more robust perspective. Rodinelli (1981) and Olowu (1995) have overhauled Maddick's definition of decentralization and its major form of deconcentration and devolution even though from the same perspectives. For example Rodinelli in his study of the African situation defines this as a process which "allows local managers greater discretion in decision making so as to enable them to cut through the red tape and the ponderous procedures often associated with overcentralised administration". More recent authors for example Stohr (2001) broadened the definition as

> the transfer of responsibility for planning, management, and resource raising and allocation from the central government and its agencies to lower level of governments.

He added that it carries with it, the principle of "subsidiarity" which proposes that functions (or tasks) be devolved to the lowest level of the social order that is capable of completing them. According to the UNDP (1999), subsidiarity connotes decentralizing governance through the restructuring of authority so that there is co-responsibility between institutions of governance at the central, regional and local levels, tailored toward increasing the overall quality and effectiveness of the system of governance while increasing the authority and capabilities of such national levels. The latter part of this definition has added value to the concept. Hitherto it was seen as local government's capacity or autonomy to provide or deliver services. Recent trends look at it as not just delivering services but the personnel and institutional capacity building processes and more recently on the part of the communities as they play their role in service delivery (World Bank, 2003).

Two examples are pertinent here. First is the American experience where the Federal Government from time to time channels certain federal controlled services through Counties, Townships, Councils and Cities by providing standards, powers and resources for providing these services on behalf of the Federal Government. This in turn builds the capacity of LGAs. This is unlike the Nigerian situation where the higher tiers of government do not trust the capacity of LGs and would want to do things on their behalf thus diminishing their capacity. Decentralization is not

about diminishing capacity but building and strengthening capacity of local councils. The second example is the paradigmatic shift by international donor agencies to empower local governments to develop their capacities and those of the communities (see for example World Bank Agricultural and Rural Development Projects) (World Bank, 2003).

Ruth Khare (2006), defines a decentralized system as "one which requires multiple parties to make their own independent decisions." Such decisions are local autonomous decisions towards its individual goals. There is minimum interference from centralized authority.

1.2 Decentralization and Democracy

The issue of decentralization and democracy takes us to three issues.

a) the definition of democracy.
b) the interconnectedness of the concepts including how reciprocal the concepts are.
c) the implication of both for development or service delivery.

1.2.1 Definition of Democracy

This lecture does not go into othordoxy in the definition of democracy. Nevertheless, according to Stuart Mills (1962), democracy relates to three key tenets of utilitarianism, liberty and representative government. Therefore, democracy can be construed as greatest benefit for the greatest number, freedoms and rights of people and a government of the people through their representatives that is capable of protecting and guaranteeing the first two tenets.

Democracy according to Huntington (1991: 7) is a system in which its most collective decision makers are selected through fair, honest and periodic election in which candidates freely compete for votes and in which virtually all the adult population is eligible to vote. This definition looks at democracy as process of political recruitment through electioneering, culminating in representative government.

The definition that follows looks at democracy from the point of view of governance. Mbachu (2009: 5) states that "democracy involves putting in place good governance that will represent the interest and aspirations of the people. It does this through representative institutions that effectively and efficiently

manage the resources for the people accountably and transparently, using the constitution and adhering to the rule of law:" Bamidele (2011:54) added a similar voice when he opined thus "Democracy is inherently attached to the question of good governance which has an impact on all aspects of development efforts...also people participate in decision making process that affect their lives."

A third layer of definition of democracy especially within the context of decentralization is from Bingel (1989:3). This he states as "that system of community government in which the members of a community participate directly or indirectly, in the making of decisions which affect them all." This idea is similarly shared by Anshi (2000) where he states that democracy should be "a system that is tolerant and respects the freedom and integrity of all occupants of the geographical entity for which democracy is anchored..." Ideally it should be "capable of putting in place a system of governance that caters for the needs and aspirations of the general populace.

These definitions of democracy have addressed the ideals of democracy, governance as the translation of these ideals in everyday life, and the issue of participatory democracy and service delivery as the reality or dividends of democracy.

The important issue for this paper however is that democracy must interact, interface and support decentralization for development to take place. For example, community participation on decision making and service provision connotes devolution, even of democracy. Good governance at both higher and lower levels of government is symptomatic of effective decentralization.

Scholars have commented on this seeming two face of the-coin syndrome. USAID (2000) observed that decentralization is about power and is therefore a fundamentally political process. Specifically, decentralization is about handing over power to the local people typically from the central government. So this shows that the inherent nature of democracy and politics in decentralization. This is why we are tempted to say that decentralization that is effectively supported by the democratic process (devolution) is more likely to promote development than the top-down model (deconcentration). Absence of democracy is injurious to effective decentralization as autonomy is seriously

encroached on with the resultant effect of poor local initiative and poor services.

According to Enemuo (1999) many donor agencies and international finance institutions such as the World Bank see decentralization as a means of creating an enabling environment for development and promoting accountability which is an attribute of democracy.

To further deepen the understanding of these relationships, Work (2002) creates a distinction between political and administrative and even fiscal decentralization. In political decentralization, political power, authority, responsibilities and resources are transferred to sub-national levels of governance, which require a constitutional, legal and regulatory framework to ensure accountability and transparency. It is associated with elected and empowered sub-national forms of government ranging from local council to state level bodies. Devolution is considered as a form of political decentralization and such units are usually recognized as independent legal entities and are ideally elected (although not a necessity). Administrative decentralization aims at transferring decision making authority, resources and responsibilities for the delivery of public services from the central government to other levels of government, agencies and field offices. This is synonymous with decentralization.

The difference between political and administrative decentralization is the political and democratic undertone of the previous which is absent in the latter. It is a question of the degree of autonomy resulting from both models. Fiscal decentralization refers to the resources reallocation to sub-national levels of government. Normally such exercise is tied to budgetary practices and ideally, such arrangements for resource allocation are often negotiated between the central and sub-national governments, based on several factors such as interregional or state equity, availability of resources and fiscal management framework and capacity (Work, 2002).

Democracy and decentralization are therefore intertwined and require a fiscal decentralization framework to support them with a view to providing development (services).

1.3 Development from the Perspective of Decentralization

The enduring relics of the meaning of the concept of development within a decentralized entity like local government still rests on the age long conception of movement from tradition to modernity (Whitaker, 1970). We are not talking of macro or universal meanings as is obtainable at a macro level. Development at the decentralized level is a way of responding to the Maslow's (1970) physiological and social needs of community members in form of services. It involves creating the infrastructures that would support the standard of living of communities and directly investing in the human capacity of the people. According to the UNDP (1999) service delivery which flows out of this is "a set of institutional arrangements adopted by the government to provide public goods and services to its citizens".

Development according to Goulet (1971) is "sustained elevation of the entire society and social systems towards a better or more humane life", the objectives of which are life sustenance, self esteem and freedom. These are economic, social and political objectives.

Development contextualised in local governments, would refer largely to rural development. Lele (1975) defined rural development as improving living standard of the mass of the low income population residing in rural areas and making the process of their development self-sustaining.

According to Todaro and Smith (2003:14 – 25) development deals with issues such as poverty, inequality, unemployment, population growth, environmental decay and rural stagnation. Todaro argued that we should be moving beyond the traditional view of development which addresses issues of economic growth, expressed in the gross national product, gross domestic product and the various indices of the rate of economic development and incorporate social indicators such as gains in literacy, schooling, health conditions and provision of housing which constitute more of Human Development Indicators (HDI). The new economic view point according to the authors advocates for the "dethronement of GNP" and elevation of direct attacks on widespread absolute poverty, increasingly inequitable income distribution and rising employment. This is a confirmation of Seers (1969:3) when he reduced the question of development to three key questions: what is

happening to poverty, inequality and unemployment? Todaro finally proposed that

> development must be conceived as a multidimensional process involving major changes in social structure, popular attitudes and national institutions as well as the acceleration of economic growth, the reduction of inequality and the eradication of poverty.

Decentralized development should therefore address the structures and infrastructures that are capable of providing economic and social services and the political values or culture that support and sustain these. This is actually the task for decentralized development. It is from this platform that some of the multiple stakeholders that participate in decentralized development take their queue. Examples of these are local governments and international donor agencies.

The point has been made earlier that LGs in advanced countries are better organized, sitting on developed economies and efficient in service delivery. In the USA for example, local governments engage in services such as running of airports and harbours. These are not the type of services for our case study, Nigeria. In Nigeria, the capacity to provide services depends on constitutional framework and the degree of devolution.

The closest issues to defining development and service delivery in the Nigerian setting are the assigned functions of local government and the role they play as decentralized entities. The roles Nigerian LGs play are political and socio-economic (Odoh, 1994). This derives from a classification of the four objectives of local governments outlined in the Guidelines for Local Government Reform (1976). This also ties in with the new economic view point presented earlier on and the multidimensional nature of development.

The political role of local governments in Nigeria is expressed through their role in democratization. Local government is a recruitment and training ground for leaders. The civic culture is aspired to in LGs. LGs are used to provide election logistics, partners in ensuring successful conduct of elections. They are useful in mobilization of the public over their rights and duties and the role

the public should play in electioneering. They provide the right context for politics and governance. In addition, LGs provide security and indeed the Chairman is the Chief Security or Peace Officer in the LG. Indeed they have statutory committees related to the Security and Police and Community issues in the LGA. They also use traditional political institutions for such purpose. LGs provide a two-way-channel of communication between governments and the people, with regards to government policies and people's demands.

The socio-economic roles of LG are directly found in the functions of LG contained in the Fourth Schedule of the Constitution of the Federal Republic, (1999) and the various state laws on Local Government. These functions are normally classified into those that are mandatory for the LGAs to perform without assistance from the State and those that are concurrent. Among the first category are economic planning and other functions such as collection of rates, establishment and maintenance of cemeteries and burial grounds, licensing of bicycles and trucks (other than mechanically propelled ones), markets, motor parks and public conveniences, roads, streets, drains, naming of roads and streets, public conveniences and refuse disposal; birth registration and deaths and marriages: tenement rates and property tax. They also include control and regulations of outdoor advertising and hoardings, movement and keeping of pets of all description, shops and kiosks, restaurants and other places for sale of food to the public and laundries and control of liquor. Note that these functions are both a service and a revenue generating function. They are very basic or primary, characteristic of the name local government.

The concurrent functions on the other hand, even though basic and social, are cost intensive since their provision is capital in nature while government hardly generate revenues from these services. They are: Provision and maintenance of basic education; the development of agriculture and natural resources (other than exploitation of minerals); the provision and maintenance of health services, "and any such other functions as may be conferred on a local government council by the House of Assembly of the State."

The provision of these services amounts to development in the local government. In so doing, the right structures and infrastructures are put in place and the concurrent functions

especially will direct the energies of local government towards modernizing the institution, the communities and help contribute to national and state efforts towards the 'ends' of the new economic view point and its multidimensional nature.

International donor agencies that have engaged in local or rural development in Nigeria have also patterned their idea of development around the new development view point and a sophistication of the concurrent functions of LG in Nigeria especially in their programmes and objectives and approach to the delivery of these services. The United Nations Millennium Development Goals (MDGs) for example has 8 goals to be achieved by 2015 (after series of shift in timeframe). These eight goals address the following (UNFPA Publications).

1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria and other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

There are three direct health goals, one direct primary education goal and one economic and agriculture related goal. The other three goals have bearing on these three sectoral areas. Indeed these are the basic preoccupation of LGAs while effective decentralization at the LG level should be able to facilitate the delivery of these goals. The success of the MDG would depend to a large extent on effective decentralization at the LG level.

The story is replete with other bodies like United Nations Children's Fund (UNICEF), the World Bank Fadama Project and the Local Empowerment and Environmental Management Plan (LEEMP). One health goal of the UNICEF country plan 2005 – 2009 for example was

a) to reduce the incidence of water borne diseases and other related problems, through the provision of good drinking water to the people (UNICEF; 2007). The project that was implemented in this respect was water and sanitation project

(WATSAN) in communities. This is a health and sanitation program of LGs.

The LEEMP, a project of the World Bank (2004) at the Community level had as its goal: to strengthen the institutional framework at federal, state and particularly local government to support environmentally sustainable and socially inclusive development. This objective is improving decentralization and service delivery and the environmental imperatives and implications of service delivery.

Development or service delivery at the local level is therefore a joint effort. The donors have defined development to coincide with the legal framework for development and service delivery even at the LG level. The difference has been that while LGs struggle to measure success at the level of output, donors have moved beyond this looking for outcomes and the sustainability of such development efforts. These two success measures still show how weak the decentralization variables and efforts are at the LG level and the stronger decentralization approaches to development by the donors.

In concluding this section one would observe that both democracy and development would need to be decentralized in order for decentralization efforts to be meaningful. Effective decentralization would hinge on building the capacity of LGAs to harness both democracy and development to improve their image among the people and other governments. At the root of such performance are two critical issues of the decentralization arrangement viz Control versus Autonomy. Control is institutional, autonomy is both institutional and democratic. Autonomy is a prerequisite for effective decentralization and development. Both legal and governance forces hold down the degree of autonomy for service delivery in local government. These are the variables that guide our understanding of the next section which attempt to provide some literature/overview of decentralization in the Nigerian local government administration and how this has affected service delivery.

Part II

Overview of Decentralization, Democracy and Development in the Nigerian Local Government System

This part of the lecture that relates to the Nigerian experience was a major preoccupation of this author's interest and focus as he journeyed into Professorship. My Ph.D thesis addressed the issue of "Autonomy as a principle of Local Government Administration in Nigeria (Odoh 1989). There have been various write ups about federalism and power sharing, Intergovernmental Relations, Democratic and Administrative Reforms in Nigerian Local Governments, Fiscal Decentralization in Nigerian Local Governments, Party Politics and Service Delivery, Decentralization and Service Delivery, etc. The materials presented in this section have benefited from such write ups.

It would be necessary to remind ourselves that decentralization refers to the degree of autonomy enjoyed by local governments – autonomy here referring to the capacity and ability to take decisions and implement these decisions with minimum interference. In the Ph.D Dissertation for example decentralization as represented by autonomy (devolution) is expressed in operational terms such as democratic autonomy (political) administrative autonomy, financial autonomy and service delivery. In fact, apart from the operational definitions provided in the Dissertation, a Journal paper titled "Understanding the Concept of Autonomy in Local Government Administration provided further operationalization of "autonomy" in Local Government (Odoh: 2004).

In this section, therefore, autonomy is used interchangeably with devolution while control relates more with deconcentration – both variants of decentralization. This point has been established from the onset. A review of decentralization or autonomy and control in Nigeria LGs is undertaken below, bringing out the status of decentralization in Native Authorities or Local Authorities, Local Administration and Local Governments. The point to note overall is

that the more modern local governments became, the better for decentralization. Modernization of local governments was brought about by a diminished role of traditional authorities in LG administration and an entrenchment of democratic processes in Local Government leadership and decision making. In this aspect, LGs moved from a Sole Native Authority to Chief-in-Council to Chief-and-Council and to the modern local government system that was completely independent of the power of the Chief as the latter were consigned into their separate traditional council and subjected to LGA control (Odoh, 1989). That is the summary of the journey from deconcentration to devolution or from control to autonomy. Whether there has been any difference in local government administration and its subsequent impact on service delivery in practice, remains the issue for this lecture.

For the purpose of better understanding, the periods to be reported are classified into the pre 1976 period and the post 1976 period which are still sub-periodised as the analysis contiunes.

2.1 Pre 1976 Period

This period was dominated by centralization of administration resulting in tight control over local government administration. This was the period largely depicted as the Sole Native Authority, Chief in Council and Chief and Council where the authority of Chiefs were preponderant over Nature Administration, so, one could not have expected any reasonable degree of autonomy for LGs. The progression however shows that the subsequent administrative/leadership model was an improvement in governance than the previous, leading the way to modernisation.

The powers of Nigerian Local/Traditional authority were greatly curtailed with the colonization of the country. Thus the various traditional rulers who were the sole native authorities and whose vast administrative control and financial resources grew by leaps and bounds before this epoch, were checked with the imposition of a Central Authority over Nigeria especially since 1914. The traditional authorities lost their Sole Native Authority attribute, became torn between tradition and modernity and experienced erosion of powers in an era of democratic upsurge. In addition to this, as pointed out by Adegbite (1980), with every reform in the LG, and with the increasing modernization of these

institutions, there has been the tendency for the powers of traditional rulers/authorities to be diminished.

Of course under colonial administration "one with the District Officer is majority" and the District Officer could even annul the decisions of the Chiefs whether "natural" or "warrant". Indirect rule therefore maintained or preserved the Chieftaincy institution, gradually injected modern bureaucracy into LG administration, but granted little autonomy to the institution. In fact, the role of the D.O. was like that of the Prefect in the pre-1981 French system. Moreover, the democratic process was inconceivable in some of these LGs especially in the Northern part of the country until the early 60's while the West and Eastern Regions had started these practice since the early 50's. The implication of such for the autonomy of LGs was that N.As. in the North had all this while, depended on the iron hand of its traditional rulers – who were the prime movers of these institutions as far as the British instrument granted them the power to do so, while in both West and East, even though both were subject to the same control of the D.O; local participation and representative government leading to some autonomous decisions had already germinated in these region ahead of the more organized and entrenched N.A.s of the North.

Hence, in the Eastern Region, the N.A. Ordinance of 1950 was replaced by a system of County, District and Local Councils in 1955 – a liberal conception based on the British model. During this period too, the West took to the British model with the reform of 1953 introducing elected representatives constituting ¾ of the Councils. In addition, a three tier system of divisional, districts and local councils was operated. The Northern System revolved strictly around traditional rulers while the N.A. law of 1954 consolidated this arrangement.

In the 1960s, the East moved from LG to Local Administration. The famous Olu Obodo summarizes this. But there was tendency for more governmental control while at the same time stimulating local participation through the Divisional and Community Councils. In the South Eastern State, Development Councils and Urban Community Councils were created. The point here is that with Local administration rather than local governments, the constitutional and administrative powers of LGs were encroached on – autonomy only amounted to powers enjoyed by

functional bodies which was dictated by the regional government. This was just a question of deconcentration and it was not surprising in an immediate post colonial administrative context.

The period of the early 60's in the West was not too different. Various experiments were made – the American city Manager type, Area Committee Councils, etc., yet these were hampered by financial and bureaucratic constraints despite the availability of qualified Councillors.

For the North, in 1963, there was a decision that all N.A.s should have some elected members while in 1966, the military announced the take-over of the N.A. Police, Prisons and Courts owned by regional governments, created more states thereby reducing the powers of traditional rulers through splitting of larger LGs. while the principle of representation by elections was established (Oyediran & Gboyega, 1979 : ch. 9).

The tendency for greater control over the various LGs in the late 50's and early 60's (observed above) resulted from partisan politics since LGs were the basic units of political power and the nearest governmental institution that could effectively be used to mobilize the masses. Any talk of administrative or constitutional autonomy would have been manipulated by the opposing party. In other words, an autonomous LG could question certain powers of the regional government, and this the regional government was not prepared to brook, moreso when it ought to guard its political gains jealously.

Under the Military (before 1976) LG administration did not alter radically. It was the same Council system with the traditional rulers still enjoying some considerable vestiges of power and control albeit the centralized nature of the federal administration. The impact of LGs in the South was almost negligent, as will be seen later (Aliyu & Kochn, 1982). So far we have discussed administrative autonomy before 1976, what about financial autonomy?

2.1.1 Financial Autonomy

In terms of financial autonomy, the pattern also followed the above in that, the more organized LG system in the North had well established financial sources even before its cooptation by colonial

rule, which it "indirectly" exploited using traditional rulers, organized native treasuries and later, at independence, became responsible for the comparative performance over their Southern counterparts. To buttress this, by 1927 there were 24 fully organized NAs in the North and 5 in the South. Through a decision of the Colonial Secretary of State all LG retained 70% of their total tax collected in their areas. So also while NAs in the North raised a total of £536,007 in 1919, those in the East had £1,656. Furthermore, while grants for the Western region between 1952 – 59 increased from £200,000 to almost £1,300,000 in 1959/60, it had been declining with an all-time record of £750,000 in 1966/67. So, whereas between 1954 and 57, about ½ of the LGs revenues came from grants, since 1961 less than 20% had come from this source. Compared to the North, grants had been rising steadily in the 60's even though it constituted below 15% of LG revenue (Rowland, 1979). The point is that the North had every reason to depend less on grants because of their buoyant internal revenue base unlike the West, yet the regional government paid a steady attention.

Summarizing this issue of viability of LGs, the Report of the Committee on the Federal and State governments' financial contribution to Local Governments (1977 : 11) observed thus:

> ...the extent and nature of state governments assistance to local governments varied greatly from state to state. In some Northern states, for example, the government grants have covered wide range of local government services such as dispensaries, maintenance of civil lunatics, forest reserves, agriculture, roads, welfare, staff libraries, public enlightenment, education and rural development workers etc.
>
> ...In contrast to the above, in the Southern States, there has been a more restricted field for government grants and in some of these states, only a few grants have been paid.

Adedeji (1979) also observed that while the creation of six States in the North had expanded further the relative importance of LGs in the North, vis a vis the new state authorities, the creation of six in the South had revealed the relative unimportance of LG in that part.

And this importance can be highlighted in table 1 (appendix) where, for example, the combined finances of LGs for North Eastern State was 124% that of the State Government in 1968/69 financial year while for states like Rivers and Anambra, only 10% was recorded. It was only in Lagos that 51% was recorded which was about the lowest for any Northern State.

The comparison of North and South above intends to bring to the fore the fact that viability of LGs is contingent on administrative and financial variables and that even the latter could possess more influence. Democracy or participation or representative grassroots government could be no guarantee for viability or autonomy because the East and West that introduced this before the North had nothing to show for it in terms of viable LGs. The issue of autonomy of LGs cannot be found in representative grassroots government only but in financial resources and management which compels intergovernmental relations to operate in a certain manner. It also confirms that even though, there was an overall pointer to strict surveillance over LGs by the Regional/State governments during this period, the implication of this for LG autonomy varied from Region to Region or State to State.

2.2 Local Government Autonomy under the 1976 Reforms and the Second Republic

With the introduction of the 1976 Local Government Reforms, fundamental changes were effected. The varying systems of Local Governments in the country were harmonized, streamlined and standardized – a sort of uniformity in structures, functions and operations. Second, a Traditional Council accommodated the interest of traditional rulers which itself became secondary to the Local Government administration. (It became advisory in nature). A third major change was the streamlining of Local Government finances as spelt out in the Guidelines. Grants came to play a dominant role as a source of Local Government finance while the internal sources became rather inelastic with the abrogation of their hitherto dominant source in the North (community and cattle taxes) (Guidelines, 1976).

During this period too, the constitutional existence of Local Government was guaranteed on a nationwide basis, while Local Government was integrated into the overall Revenue allocation

structure/formula for the federation (Federal Government of Nigeria, Constitution 1979, section 7).

2.2.1 Administrative Autonomy

Local Government under the Second Republic was a subordinate creation of the State government. Having been given the powers to establish, determine its structure, composition, finances and functions, the state governments thought it better to operate along the lines of the Guidelines to the Reforms, part of which was integrated into the 1979 Constitution. Various Edicts were formulated from these broad Guidelines and modified in line with the Constitution.

Two major functional institutions regulated the activities of Local Governments during this period, viz: the Ministry for Local Government and the Local Government Service Commission/Board. The State Executive as a political institution had also its own share in the control. These political and functional institutions, in their dealings with the Local Governments, one way or the other, influenced the degree of autonomy of Local Governments. Let us take these one by one, beginning with the political institutions. This shall be done summarily.

Under the Second Republic Local Governments were reduced ordinarily to the creation of the State Governments through the instrumentality of the Governor. This is often referred to a political interference. The very fact that Local Government elections were not held throughout this period, left the Governor with absolute powers to constitute, dissolve or reconstitute the Local Government Councils. They preferred to appoint Caretaker or Management Committees who they could easily control along party and selfish lines. It reduced Local Governments to a worst form of deconcentration. Even the system of reward whereby the Governor could create new Local Governments (with the support of his assemblymen) as a reward for electoral support had untold effects on the viability of new Local Governments and hence their autonomy.

Apart from the State Assemblies being carried along in the creation of new Local Governments, they also determined the allocation of public revenue to Local Government Councils within the State. In a State dominated by a single – party, the minority

Local Government could be sanctioned through such an instrument. Moreover, laws for Local Government elections were not passed by the State Assemblies (in conjunction with other bodies) thereby leaving Local Governments in perpetual dependence on the whims and caprices of the state administration.

For the functional institutions, the Ministry for Local Government, rather than coordinate the activities of LGs, interfered with their operations. There were even cases of Local Government estimates not cleared within the budget period, thereby paralyzing the various activities of Local Governments. Bureaucratic procedures held up Local Government day to day administration because clearance had to be sought on major issues beyond the constitutional control of the unit Local Governments. (However, there were incidents where some Local Government Chairman and Councillors who were seen by the government as the main source of support sometimes resisted control which they regarded as interference). The Inspectorate could not perform effectively with the unfortunate consequence of poor management of finance of the Local Government.

Local Government staff often complained about the Local Government Service Commission/Board because of its reckless and partisan handling of recruitment, posting, transfer and promotion matters. Moreover, the problem areas between the Service Board and the Ministry for Local Government slowed down the progress of work in Local Governments.

2.2.2 Financial Autonomy

Local Governments were financially crippled under the Second Republic inspite of the fact that a new innovation of statutory grants from the Federal and State governments was built into the system. It was ironical that the period when these units got additional financial support from the Federal Government was the period they least performed their functions or demonstrate any real position of strength or autonomy (except for a few urban Local Government especially in Lagos).

Studies have pointed out the real source of weakness in Local Government finances during this period – this included: the little attention paid to the internal source of revenue, withholding and diverting grants meant for Local Governments by State

Governments, while on its part not honouring its own share of the allocation to Local Governments, which in turn diminished the meagre resources for management purposes. The primary education element and the withdrawal of direct Federal Government subsidy was a real thorn in the flesh of Local Governments. Primary Education consumed an average of 70% of Local Government funds leaving it with 30% to run the rest of its services (Report, Primary Education 1983). Moreover, the allocation of funds from the Federation Account sent most of the Local Governments into a lull, with little or no attempt to exploit their internal sources.

In an earlier study, I did on the financial dependence of Local Governments it was discovered that the financial autonomy the Local Governments used to enjoy before the Reforms and especially before the Second Republic (in the North) had vanished, with the abolition of key tax areas (Jangali and Community tax which used to constitute 80% of their total revenue). The reverse was now the case where internal sources account for 20% and in many cases much less. Second, I advocated that for meaningfully mention of autonomy, Local Governments should consider the grants from the other tiers of government as given, while turning inwards primarily to exploit their internal sources. (Table 2.2 below shows the miserable nature of this internal revenue generation effort). Asking for more funds was rather a marginally effective option. At the disposal of Local Governments were an array of revenue Heads like Property, fines, fees, rates, loans and investments (Odoh, A. 1984). Research has shown that apart from market fees, Local Governments failed on most of these. In an appraisal study carried out by the Department of Local Government Studies, Ahmadu Bello University, Zaria, it was discovered that no Local Government committed up to 3% of its funds to investment with more than 70% of the Local Governments falling below the 1% mark, which sharply contradicts what obtains in advanced capitalist countries (Department of LG Studies (1985).

The argument is often made that if political interference was minimal and the State Government had honoured its financial obligations to Local Governments through the various institutions as required by the Constitution and if Local Governments had tapped their internal sources, the so called financial autonomy would have been achieved. The credibility of such argument was demonstrated by the quasi financial autonomy of Lagos Local Governments.

Table 2.1: State and Local Government's Approved Estimated Revenue, 1968/69

(1) States	(2) State Government Revenue £M	(3) Local Government Revenue £M	(4) (3) AS Percentage of (2)
Benue	4.27	3.16	74.0
Plateau	n.a.	0.11	-
East	6.86	3.22	47.8
Central	2.47	2.43	98.0
Kano	10.51	5.41	51.0
Kwara	11.99	1.78	15.0
Lagos	4.66	5.76	124.0
Midwest	3.62	2.78	77.0
North-Central	8.23	0.62	77.5
North-Eastern	6.44	0.25	4.0
North-Western	20.11	3.17	15.0
Rivers			
South Eastern			
Western			
Total	**84.43**	**31.13**	**36.6**

Source: Approved Estimates of State and Local Governments 1968/69.

Table 2.2: Percentage of Local Revenue from Total Revenue 1976-81

LGs	State	Years					
		1976/77	77/78	78/79	79/80	80/81	81/82
Argungu	Sokoto	13.5	9.1	8.8	8.1	4.6	4.5
Gazawa	Kano	2.6	6.9	8.9	3.6	3.6	7.6
Hong	Gongola	23.2	11.4	12.2	13.1	8.9	9.6
Kazaure	Kano	-	11.0	20.7	5.5	3.6	1.4

Source: Odoh A. M.P.A. Thesis 2004

2.3 Decentralization between 1984 – 1990

2.3.1 Immediate Post Second Republic Era (1984 – 1985)

The post 1983 military era had infused discipline, prudence in financial management and meticulous exploitation of revenue sources into the operations of Local Governments. In a paper presented by the Sole Administrator of Jahun Local Government, then Kano State, (now Jigawa State) he took us through the ordeal of having to put together a financially battered Local Government at the inception of the military and how almost 8 – 10 months later the Local Government could stand on its own and pay salaries of its workers promptly. This was how he painted the negative picture.

> In Jahun, it is discovered that besides decline in revenue, one factor that seriously hampered progress was the reckless manner in which expenditure was committed...As at January, 1984, it was estimated that over N400,000 remained as liabilities of the Local Government while the cash in hand did not exceed N10,000. These liabilities did not include loans granted to the state government by the Ministry which was discovered to be about N225,727.02. It became traditional that salaries and wages for any month could not be paid until federal grants were received. The task facing the new administration was to reverse this trend. (Sambo, 1984).

This, according to him, was done within 10 months especially the latter. We believe that many Local Government were worse than Jahun. But the new era, through its internal revenue efforts and prudent financial management was able to overcome its problems despite the economic situation of the country. At least workers salaries were being paid and the primary schools had been functioning on continuous basis (albeit repressive measures of some governments) while some closed down projects had been revived. These are the indices that should be used to measure autonomy rather than a representative system at the grassroots per se. Administration should be undertaken for development while democracy or local representation should be secondary. It is agreed that administrative autonomy was being sacrificed then because of the highly centralized nature of the administration but financial autonomy is capable of diffusing such deprivation which in turn transforms into development. This Jahun case was an example of

how the military era promoted better organisation and service delivery than the civilian period where politicisation of Council led to chaos in LG administration, financial and service delivery.

2.3.2 The 1985 – 1990 Era

The pre-1991 experience concerned the implementation of the Dasuki Report, the transition programme and the zero-party based elections. These were various democratic experiments that test run the return to civil rule. Local government was the guinea-pig which was reinforced in different ways, all to promote autonomy and viability.

When the Babangida administration assumed power in 1985, it attempted to prop up Local Government through various reforms, pronouncements and operations. It inherited the Dasuki Report in 1985, which recommended a Caretaker Committee System for local government, with a view to their being democratized later. Dasuki recommended the cutting down of the number of councilors, since many Councils could not shoulder their emoluments and allowances. He also recommended a jacking up of statutory allocation to councils while encouraging councils to pay greater attention to their local revenue effort. Babangida virtually adopted all these measures and thereafter, set on a course to devolve more powers to local governments.

From a democratic perspective, he arranged a zero party election for local governments in 1987 but dissolved councils six months to the end of their tenure. In 1989 another election, this time on 2-party basis (the National Republican Convention (NRC) and the Social Democratic Party (SDP) was conducted. This lasted till 1990/91 when another election was held, this time to usher in the Presidential system into local government. This was the biggest innovation during this period. The elections and councils of 1987 and 1989 did not deviate seriously from former experiments since their autonomy were curtailed. The 1989 and 1991 Councils got some breather through some reforms enumerated below (Odoh, A. 1993) and (Gboyega, 2000).

a) The abolition of the Ministry for Local Government and its subsequent replacement by a Department of Local Government (assigned relatively fewer powers);
b) Budgetary restrictions and delays were minimized;

c) Direct funding of local government from the Federation Account into Local Governments own account, i.e. the abolition of the State Joint Account Fund;
d) Increase in local government statutory allocation from 10% to 15% and later on to 20%;
e) Transferring the responsibility for Primary Education to a Primary Education Board;
f) Transfer of some Primary Health Care functions together with institutions, personnel and "funds" to local governments;
g) Complementing the rural development efforts of local government through the establishment and operations of the Directorate of Foods, Roads and Rural Infrastructure (DFRRI) and the Directorate for Social Mobilization (MAMSER);
h) Special take-off allocations for newly created local governments and periodic doling out of funds to meet some capital needs of local government like roads, transport and education;
i) The 1989 Constitution, which had in Section 7 given better protection to local government;
j) The presidential system in local government which held a lot of promise for local government autonomy.

The outstanding feature of this period was the experimentation with the Presidential System. Let us look this in some detail.

2.4 The Presidential System and Local Government Autonomy (1990 – 92)

In 1989, the "Local Government (Basic Constitutional and Transitional Provision Decree" was promulgated. This as the name suggests was to take local governments through the transition period billed to terminate in 1992. In this Decree, the gains of the Local Government system since the 1987 democratic experiment were consolidated, including some of the reforms that had taken place within the period.

However, it was not until 1991 that the Presidential system was decreed. Subsequently an amendment Decree (No. 23) was promulgated which amended the 1989 Decree.

The major features of the Presidential system were, the separation of powers between the executive and the legislative (council) in local government. In addition the checks and balances that derived out of this would provide for autonomy and accountability. The major features of the Presidential system in local government are outlined in a separate Guideline. (Presidency, 1991).

These guidelines were meant to expatiate on the theory of separation of powers and checks and balances.

From the wave of romanticization with local governments (either for political/altruistic purpose) or for real purpose of empowering these units of development, the Presidential system was one of the experiments that served such an agenda. Credit must however be given to it for the autonomy it held out for local government.

Local governments were empowered to debate and approve their own budgets and also make their own laws. The Councils could in addition to these, vet local government monthly statements of income and expenditure and monitor project implementation.

It was hoped that with each arm of government being separate on roles and responsibilities, and acting as a check against the other, there would be no need for the excessive control hitherto exerted by the State Governments.

In fact, initially, local governments were empowered to recruit and manage their own staff as the Local Government Service Commission was then scrapped. This only lasted for six months because the Chief Executives of local governments turned his new-found autonomy into a witch-hunting and victimization exercise. The tenure and stability of local government career staff were seriously jeopardized. This forced the Federal Government to re-instate the Service Commission. (The Presidency, 1992).

In terms of funding one could safely say that the period 1991 – 93 was one of the most prosperous for local governments. Statutory allocation increased from 15% to 20% designed to support the Presidential system. There was also a stabilization account and later on, local government came to benefit from the Value Added Tax (VAT).

Accountability was enhanced as impeachment and recall clauses were built into electoral and "operational guidelines" of local government. Despite all these concessions to local government

as reflected in their finances, momentary relaxation in staff control, whittling down of the powers of the State Departments for Local Government and democratization that created consciousness of service and accountability, there were little signs on the ground to show for these enormous powers. Instead, there were accusations of massive corruption on the part of the Chief Executives and even confrontation with the State governments. The autonomy conceded to local government was interpreted to mean autonomy for the political actors rather than autonomy for the local government as an institution and its people. Such massive failures in the use of autonomy led to interventions here and there on the part of the superior governments, like the removal of confrontational local government chairmen, dissolution of docile and corrupt councils and even probes into some others. (The News Magazine, 1996).

The real issue however was that the period of 1991-93 was when real attempts were made to devolve powers to local governments adequate enough to label them as autonomous, and even meet the criteria of autonomy. But the fact that this experience failed could be traced to a number of factors. First, that the concept of autonomy was misconstrued (as stated earlier) either inadvertently or intentionally and second, that the legislature allowed itself to be tele-guided and bamboozled by the Chief Executive of the local governments and therefore abandoned their key role as a check and balance institution. In fact the powers enjoyed by a chairman was a function of the activity and activism of the legislature. Two illustrations from two local governments attested to the manner of operations of the system.

Writing on Zaria Local Government, Kaduna State, Adamu (1992) observed that the noticeable failure of the system could be attributed to the following:

- The Chairman of the Executive Council was seen to be attending meetings of the Legislature when he was not supposed to.
- The State Government interfered in the affairs of the local government by passing on to it extra-budgetary responsibilities from time to time. An example of this was the forfeiture of N2 million by each local government at one point, and the responsibility to refurbish State Secondary Schools in their area of jurisdiction.

Furthermore, he observed that in Zaria Local Government

> ...the elected leaders use the Career Officers to fulfill their selfish interests to the detriment of the Local Government interests. For instance, there were cases when these political leaders siphon the resources of the local government and divert them to their own personal use.

On the issue of accountability, he remarked that:

> ...the electorate mostly lacks the political awareness that would enable them demand for accountability from those they elect to represent them.

These issues above suggest that the spate for democratization in local government and the autonomy that accompanied it was a cover up for manipulations and personal gains. Democratic power, an important issue in autonomy was actually hijacked by the representatives of the people and the state governments leaving the people helpless even in the area of accountability.

A second example was from Ekiti South West Local Government of former Ondo State, where Ebenezer found that:

> ...the political conflict between the Executive and the Legislative arm is one of the problems facing the system in the local government. Another major problem is the conflict within the members of the council. The two factions in the legislative House always quarrel on every flimsy excuse. In view of the quarrel within the council, they have failed to serve as a watchdog for the executive. Their meetings are not conducted openly and in most cases meetings are not held. The strained relationship between the executive and legislative did not allow for the smooth functioning of the legislative arm....moreover the local government chairman wields enormous powers in the absence of a vibrant legislative council. (Olutope, 1992).

The above is a reminder of how the legislature under the Presidential System in local government weakened itself and fell prey to the whims and caprices of the executive thus making

nonsense of the checks and balance which would have guaranteed autonomy for the council.

At a broader level and in line with the above observations on the two local governments, Bello, pointed out that:

> We saw that in many Local Governments in Northern States of Nigeria, not much has been achieved. What we saw through direct contact and discussions with chairmen and supervisors on one hand and councilors on the other were and still are:
> - Political inexperience on the part of most councilors who regard political office as means of making money.
> - Lack of seriousness by Councillors to settle down to the business of governance;
> - Dictatorial tendencies by many chief executives either in pursuit of personal aggrandizement or taking advantage of the political weakness of Councillors who are supposed to serve as checks...
> - Insensitivity of many chief executives to the demands and expectations of their people due to selfish reasons of politics of deceit. (Bello, 1993).

The net effect of these observations and experiences was that even though autonomy was a major objective of the system, the managers did not allow it to nurture and so did not rise above mediocrity. Consequently these local governments ended up neck-deep in corrupt practices and other bad management practices.

2.5 Democratic Reforms and Autonomy since 1993

2.5.1 Democratic and Administrative Reforms

Since the Presidential Reforms terminated in 1993, there had been no other structural reform of a political nature in local government until recently. Instead, the system relapsed into the traditional cabinet system except for the fact that nomination/confirmation of local government chief executive did not have to be done by the State Chief Executive (unlike in the 1977 situation). This Parliamentary type situation continued for some time and very little or no attempt was made to contemplate any new system. Even after the no party elections into Councils in March 1996, the attentive local government public seemed to be at a loss as

to certain knotty issues in local government administration, especially the role of the Executive Council (FGPC) and the LG Council including their relationships.

It should be noted that nothing had changed with the politicians in the nine months of local administration under the zero party regimes in local government in 1995. The story had worsened especially with the increased poverty and greed of politicians. Interventions by State governments which always took away the real powers of local government were rampant. The spectacle of such, only bemused or surprised the people. The abuse of the democratic ideal and process continued. This did not come as much of a surprise since a military administration's tolerance for democratic institutions and processes normally stops where these infringe on their own real political interest.

The party-based elections concluded early 1997 was however supported by a more coherent and standardized guidelines for local government administration (from the Presidency) (Federal Republic of Nigeria Gazette, 1997). From all indications, local governments became more of Federal government's pre-occupation than State's. Of course this was the type of relationship and control needed by the federal government to continue to shore up its legitimacy to govern.

The reconstituted councils of March 1997 was based on a 5-party political contest. The noise generated by the election, resulted from Abacha's government support for a particular party. Because of the extreme partisan nature of these five parties, and the fact that they were all described sometimes as government parties, the local government councils owed their allegiance largely to the superior governments rather than the electorate. This was why the level of government interference was very pronounced. Such interference came in form of directives to fund one government programme or the other. Examples of such programmes were the Family Support Programme, General Sani Abacha's self succession campaigns, (especially the 2 million Man March), visits by "important dignitaries" to local governments, impromptu orders from State governments on rallies and sponsoring of teams/contingents from local governments, central purchases for health, educational and agricultural equipment and materials at inflated costs on behalf of local governments and other channels of wastes. All these helped to

drain local government funds and hence any meaningful attempts at planning and development.

In terms of administration, Decree No. 7 of 1997 and the "Operational Guidelines for Local Governments in Nigeria" provided the framework for management of the various Councils. The main highlights were that the Decree acknowledged that local governments were back to the Parliamentary system with the Council consisting of the Chairman, and his supervisory councillors, and the ordinary or non-portfolio councilors – a form of "fusion of powers".

Local government council (i.e. legislature) was empowered to make bye-laws, debate, amend and approve budgets, monitor and implement projects and programmes and examine monthly statements of accounts of local government. These functions of the Council (Legislature) has always re-echoed since 1991 but it became even more difficult under the Parliamentary system, since most chairmen ended up mischievously sidelining their council members preferring mostly to work with their supervisory councillors.

The Chairmen hardly called council meetings at least once every month as the Decree and Guidelines stipulated. It appeared the Chairmen did not know the use of which to put the councillors despite their stipulated roles, or alternatively, this could be interpreted as the unwillingness of chairmen to run open administration.

There were sanctions for erring chairmen according to the Decree since it empowered even the Head of State to dissolve erring councils.

During this period, democracy could be said to be on trial as the new Councils especially the chief executives had to balance the political objectives/premium which the government placed on them with the overall objectives of local government; in other words, balancing the parochial political objectives with which the military considered local governments under a transition, as against the wider political and socio-economic objectives which local governments are supposed to achieve in any country. As pointed out earlier, the political objective was overriding in the military's conception since local governments to them were more of instruments of control (law and order) and legitimization rather than service delivery institution. And this was why an unbearable chunk

of funds to local government outside personnel emoluments went into profile and image-making for Abacha and his cohorts.

Autonomy was indeed better registered under the Presidential experiment in local government than the experiments of the Abacha years.

2.5.2 Finance and Autonomy since 1991

Since 1991, Local government finances had become more stable than the earlier period. This was because, as pointed out earlier the usual practice of a State Joint Account for Local Government was discontinued in 1990 and a system of direct disbursement was put in place. A more stable revenue base was noticeable under the Presidential system with other developments like a stabilization account and later-on Value Added Tax. The revenue allocation formula also changed in favour of local government as increases were made from between 10-15-20%, as earlier noted.

Data has however showed an over reliance on Federation Account and the low level of internal revenue generation capacity of local governments this period, leading to a low level of financial autonomy.

The table below throws more light on this:

Table 2.3: Sources of Local Government Revenue Nationwide 1993-98 (N=million)

Year	Total Revenue (1)	Fed. Acct. (2)	State Allocation (3)	Value Added Tax (4)	Internally Generated Revenue (5)	% of (5) in (1)
1993	19874.5	18316.4	253.1	0.0	1035.6	5.2
1994	19222.1	17321.3	466.4	0.0	1205.9	6.2
1995	24412.7	17875.5	625.4	3558.1	2110.8	11.8
1996	23942.1	16569.7	691.1	4581.7	2027.1	8.5
1997	31183.2	20443.3	578.9	7515.0	2506.9	12.2
1998	44952.7	30199.3	1097.8	9187.3	448.6	0.9

Source: Central Bank of Nigeria, Annual Survey of Local Government Councils and Federation Account, 1999.

The issue of autonomy here concerns the financial capacity of local governments. The question of money (or total Local

Government funds) had been on the increase since 1993 especially with increased federal funding and the Value Added Tax. This followed the positive and progressive policy of the Federal government on local government finances this period. This had also continued until the present. One area that detracts from the autonomy is the capacity of local governments to generate their own revenue. Local governments have not been able to generate beyond 12% of their total revenue. In fact the average for many in the federation did not go beyond the 5% mark. This over-reliance on external sources limited their autonomy during this period. Furthermore, the State's statutory 10% allocation to local government had been either slow to come or did not materialize at all. The irony here was that even though the state governments exercised tight control over local governments, they tended to contribute the least. As if this was not enough, they reduced the financial capacity of local governments by passing extra-budgetary activities on local government. (This has been referred to elsewhere in this paper). If the point on the low level of revenue and even expenditure is taken together with the mismanagement and corruption that went on in local government during this period, we would be right to talk of the fragility of local governments rather than their viability.

2.5.2.1 Spending Limits

One last way in which local government autonomy was checked was through the imposition of "spending limits". Spending limits were introduced for local government functionaries (especially officers controlling votes, OCVs) under the 1988 Local Government Reforms. Thereafter in 1992, similar guidelines were issued as to individual local government functionary and council expenditure limits. The table below captures this:

Functionary	**Annual Internally Generated Revenue**		
	Above N2M	**N1.2M**	**Below N1M**
Chairman	75,000	30,000	15,000
V/Chairman	20,000	12,000	7,500
Leader	18,000	9,000	5,000
Secretary	15,000	8,000	4,500

Supervisor	15,000	8,000	4,500
Clerk	8,000	4,500	3,000
Heads Of Dept.	8,000	4,500	3,000

Source: Handbook on Local Government Administration, The Presidency, Abuja, 1992, P. 6.

The ability of functionaries to spend would then depend on the local government's ability to raise internal revenue. Note that hitherto, there was ceiling on expenditure for local government executive councils and legislative councils. In 1992 however, there was no need to place such limits since local governments were considered autonomous. After the presidential experiment in local government, subsequent councils until the present have had limits placed on them. As can be seen therefore, it is only in 1991/92 that local governments experienced some meaningful forms of financial devolution. Note however that after 1992, the spending limits did not have to be tied to internal revenue efforts any more since this became unpopular among local government executives.

2.5.2.2 Primary Education Funding

Primary Education, whose responsibility passed unto a National Primary Education Commission was yet to create any breather for local governments. Funds for running this function were deduced at source for the Commission. This, rather than taking away the burden from the local governments had depleted their resources the more, as local governments contributed about 80-85% of the funds needed to manage this function. (ODA Report, 1996). Furthermore, because of the initial inflated submissions on number of Primary School teachers made by states on the onset of the Commission, this had come to be used against them at the level of deductions. Moreover, urban local governments with more schools and more teachers since then suffered more deductions than those with fewer schools. This left them with miserable sources for running normal local government programmes.

2.5.2.3 State Control

The Department for Local Government in the Military Governor's/Administrator's Office which replaced the erstwhile Ministry of LG during this period remained the agency for control especially in budgetary and financial matters. Their influence was even most noticeable where local governments were managed by a Sole Administrator or Caretaker Committee. Such controls of local governments were the direct opposite of the autonomy local governments ought to have enjoyed. The Department still retained the traces of the power of the Ministry despite the fact that its powers were greatly reduced by the 1988 declaration on its status.

Finally, the Local Government Service Commission continued to exercise control over staff matters, i.e. personnel matters of the unified service. Only in 1992 was an attempt made to devolve senior staff matters to local governments but this became short-lived for reasons of political victimization and jeopardizing of job security (including non-payments to pension staff of local government).. They claimed that the protection they had always needed to exercise powers over financial and other professional matters had not been given by the Commission. Instead the Chairmen of local governments were encouraged to act ultra vires in such financial and professional matters. The actions of career staff in this case were always neglected. Autonomy was therefore subverted even in internal administration.

2.6 Decentralization Between 1999 – 2003

2.6.1 Provisions of the 1999 Constitution on Political and Financial Devolution

The 1999 Constitution addresses both issues of political and financial devolution. These were meant to establish and reinforce the third tier status of local government. The maior issues of political decentralization address democratic leadership and the other provisions of section 7, provisions on creation of additional local governments and electoral provisions. Financial devolution had to do with the issues of the Joint Account and other institutional arrangement for funding local governments.

2.6.1.1 Provisions on Political Devolution

(a) The most important provision on local government is in section 7, which states as follows:

> The system of local government by democratically elected local government council is under this constitution guaranteed; and accordingly the government of every state shall, subject to section 8 of this constitution ensure their existence under a law which provides for the establishment, structure, composition, finance and function of such councils. (Federal Government Printers, 1999).

This provision became the source of strength of the state governments on local government matters because local governments are subordinate government created and regulated by the state. The source of clash with federal authorities over local government derives from this section, so also does the source of control and interference over local government administration, despite the democratic clause.

(b) Electoral Provision – Section 7(4) defines who shall vote and be voted for at local government election. Section 197(1) provides for a state Independent Electoral Commission whose functions (as contained in the third schedule) are:

i. Organise, undertake and supervise all elections to local government councils within the state.

ii. To advise the Independent National Electoral Commission on the compilation of voters register for local government elections.

We will discover that the states have made little effort in this direction but is an asset to the states in terms of controlling electoral fortunes in local governments.

(c) Creation of New Local Governments – Sections 8(3), provides clear guidelines for going through this process. The guidelines involve stakeholders such as the State House of Assembly; Members of the House of Assembly, and the Local Government Council representing the area demanding the creation of the new local government area; the people in

the affected area in terms of (endorsement by 2/3 of them), and the National Assembly.

Provision for boundary adjustment are less strenuous than those for creation of local government (see section 8(4).

(d) Functions of Local Government – These are spelt out in the Fourth schedule of the constitution. These involve both mandatory and concurrent functions.

Ultimately, the question on local government operations or performance rests on how much and how well local governments have been able to perform these functions given the constitutional provision, especially the right supervisory role of the state.

2.6.1.2 Financial Devolution Provisions

The key provisions under these are as follows:

Section 7(5b) of the Constitution provides that each State House of Assembly "shall make provision for statutory allocation of public revenue to local government council within the state."

Section 16 2(b) mandates each state to maintain a special "State Joint Local Government Account" for all allocation from the Federation Account and the State Government) to the Local Government Council of the State.

Similarly, section 162(8) empowers the State House of Assembly to decide the formula for allocating funds from the State Joint Local Government Account to the Local Governments.

All these provisions virtually strengthen State Governments over local governments both at an institutional and operational level.

However, the Constitution makes provision for local government funding arrangement at the federal level. Here, the National Assembly is empowered under Section 162(3, 4, 5, 6) to make provision for the statutory allocation of revenue from the Federation Account to Local Governments. Under section 162(3) the National Assembly has the power to decide how the Federation account is to be shared between the three tiers of government. So also in section 162(5) it has power to regulate how the Local Government share of the Federation Account is to be distributed among states.

Moreover, section 162(7) mandates the National Assembly to prescribe the proportion of state revenue that should go into the

State Joint Local Government Account for distribution to the Local Governments.

One can see that from these provisions, the National Assembly also exercises vast control over local government funds. It is this type of dispersal of powers of control over local government between the State and Federal governments that was partially responsible for the low level of performance of local government since 1999.

The rest of this section looks at how the provisions of the constitution were applied to local government and the consequences of this for the operation or performance of local governments during this period.

In assessing such operation or issues of performance, the key questions to ask are:

- What happened at the level of state local relationship?
- What happened at the level of management in local government?
- What happened at the level of financial management?
- What happened at the level of projects or service delivery?

All these will find assessment under our framework of political and financial devolution.

2.6.1.3 Political Devolution and Local Government Performance

In terms of performance, the critical issues to be addressed here are issues in Section 7 and 8 of the Constitution. Specifically, they relate to the democratic nature of Council, State control of local government and creation of more local governments. All these can find expression within the context of intergovernmental relations.

2.6.1.4 Intergovernmental Relations and Local Government Performance

The 1999 Constitution provides for a democratically elected Local Government Council. This is the much it says about democracy at this level. As pointed out earlier, decree No. 36 of 1998 provided the elaboration of the democratic clause. This decree provided for election into political offices in local government,

system of government, the role of the Executive and Legislature, tenure of office and impeachment procedures.

In spite of these, the operations of local government in the Federation, took a dramatic turn with the kick off of the civilian administration in May 1999. Since the Constitution vested the power to make laws on local government on the State House of Assembly, most Assemblies chose to ignore or sidetrack the provisions of the decree and came out with their State Laws on local government. Such laws spelt out the structure, composition, powers, functions and operations of local governments including their financial management systems (Government Printer Katsina, 2000). Local governments that still wanted to behave as if they were under the military, soon realized that they could rapidly incur the fury of the state government if they deviated from the Law and the new environment. This was a way of stamping their authority on local government. Even the erstwhile Federal-based instruments like the Financial Memoranda and the Approved Scheme of Service for Local Government Employees became relevant only to the point where their applications did not come into clash with State Laws on Local Government.

Democratization of Councils became a sensitive issue, not just in terms of the party in power at the local government level but the tenure of these Councils. Since the Local Government elections predated the other State and National Elections, the fortune at this level was in some States inversely proportional to the party at the State and Federal levels. For example, in States like Kebbi and Zamfara, and Jigawa, there were more Councils that were controlled by the opposition party in the state than the party in power. These were considered irritants to the system by the State Chief Executives and right across the country, there were attempts made to short circuit their tenure by either dissolving or suspending them at the slightest provocation. Another strategy was to get the State Assembly to peg their tenure at 2 years while the National Assembly threatened to review this to 4 years. The States finally succeeded by getting the Supreme Court to pass a judgment in their favour in 2001, which led to the eventual dissolution of Councils by the States. Since then, no election had been conducted into local government councils during that period. This was a negation of

political devolution as it threatened the existence of local governments.

Throughout this period, there had always been tug of war between the States and the National Assembly over the constitutional interpretation of ownership and control of Local Governments. Apart from the tenure case above, there were other issues such as

a) The rejection by the State Independent National Electoral Commission (SIEC) of move by the Independent National Electoral Commission (INEC) to conduct local government elections; (New Nigerian Newspaper June 10, 2001).
b) Thirty six State Speakers versus National Assembly at the Abuja Federal High Court over alleged usurpation of their powers of the Senate; (New Nigerian Newspaper, May 8, 2001).
c) Nigerian Union of Local Government Employees (NULGE) planned show-down with Federal Government over suspected move to abolish Local Government (March 2003); (Vanguard Newspapers, March 21, 2003).
d) Federal Government appointed a Committee to review the structure of Local Governments in Nigeria (June 19, 2003); (Guardian Newspapers, March 21, 2003).

On the other hand, some state governments had dissolved or suspended councils along the line, for a host of reasons, principal among which were mismanagement of funds, corruption, threat to peace, confrontation. For example, in Kaduna State, eleven local government chairmen were suspended for financial misconduct. (NNN, May 23, 2000). In Zamfara State, the Governor in May 2001 suspended the Tsafe Local Government Chairman after a probe conducted by the State Assembly, which supporters of the Chairman described as "vendetta by the APP controlled House." To them he was sanctioned for daring to stand up to the Governor from an opposition PDP platform. (New Nigerian, June 25, 2001). In the same manner, the then Deputy Governor of Bayelsa State threatened to deal with "any Local Government chairman found to have misappropriated public funds... in accordance with constitutional provisions". This was after his assessment tour to verify the performance of local government chairmen. Earlier on, Report on a Staff Audit just submitted to the State Government had indicted most local government chairmen for misappropriation of funds.

(NNN, June 24, 2001).

The story on threats and sacks by State Governments of Local Government Councils and Chief Executives were prevalent, everywhere, but the common reason was financial misconduct. More on this relationship will be highlighted under the section on financial devolution.

2.6.1.5 Creation of Additional Local Governments

One important issue in political devolution is the creation of additional local governments. Relying on Section 8 of the Constitution, State governments undertook some reckless creation of local governments. This was despite the fact that the National Assembly refused to recognize these new local governments, even for revenue sharing. At the heat of the creation exercise the Federal Attorney General pointed out that it was illegal to fund the new Local Governments from the Federation Account. The States however relied heavily on the resource base provided by the State Joint Local Government Account to be able to fund these new entities. In an appraisal study carried out on Local Government under the Fourth Republic, it was discovered that statutory allocation from Federation Account constituted 90% of the fund base of new local governments while other sources included Special take-off grants by the state government; donations and internal revenue. Initially some States funded the new local governments from the funds accruing to the parent local governments, but eventually, both old and new local governments started drawing from the Joint Account using the same formula. (Department of LG Studies, ABU Zaria, 2003).

The following table is a summary of new Local Governments created between 1999 – 2003 in States of the North West geo-political zone:

S/N	States	No. of old LGs	No. of new LGs	Total
1.	Jigawa	27	40	67
2.	Kaduna	23	46	69
3.	Kano	44	-	44
4.	Katsina	34	30	64
5.	Kebbi	21	20	41
6.	Sokoto	23	-	23
7.	Zamfara	14	20	34

* Note that in November 2003 three other local governments were created in Zamfara State bringing the total of new local governments to 23 and total number to 37.

States in other zones had gone ahead to create local governments. For example, on the eve of his departure, Governor Bisi Akande of Osun State created 16 more local governments. We also know Governor Daniel of Ogun State abolished the new local governments created by his predecessor when he assumed office.

In his address to the nation on the need to reform local governments, President Obasanjo had observed that 500 new local governments had either been created or were being created nationwide. (Guardian Newspaper June 19, 2003). Apart from funding problems, the criteria for creating these local governments were not clear. Taking the population criterion, it was difficult to see how these new local governments met the 100,000 population requirement for the Dasuki Report. In a data collection exercise for the Technical Committee on the Reform of Local Government, no local government nor Ministry for Local Government could give us the population of any of the new local governments. The question then is on what basis were they created? Even the issue of viability was not upper most in the minds of the creators of these local governments. The exercise was done largely for political reasons. In a lot of cases, the steps required by Section 8 of the 1999 Constitution were not followed and that was part of the reason why the National Assembly refused to recognize them. Summarizing this section, intergovernmental relations was not in favour of political devolution since councils were not democratically reconstituted, New local governments were not created for reasons of viability but for political reasons and the fact that there was serious encroachment on council leadership by the State government through sacking, dissolution or suspension. Councils were not allowed to make mistakes and learn from them.

2.6.2 Financial Devolution and Local Government Performance

The Constitution guarantees a continuous flow of funds to local governments from the Federation Account. It did not only create a formula for doing so but an institution where these funds are channelled through. While the formula could be reviewed as the

need arose, the institution was not subject to similar review unless the National Assembly deemed it fit. The problem with local government finance over this period rested not so much with the formula for allocation nor the volume but the mechanism through which it was channelled. Secondly, another problem area was how these funds were managed at the local government level. Let us look at these areas and the problems associated with them.

2.6.2.1 The State-Joint Local Government Account

The Joint Account was supposed to hold all statutory allocations from both the Federal and State governments (including VAT). This would include precisely 20% of revenue from the Federation account and 10% of States internally generated revenue and amount accruing to local governments from value added tax and other Grants.

Most State Governments did not create this Account in the first year of their administration but as the idea of the creation of more local governments started gaining momentum, State governments hurriedly created the Joint Account to facilitate a more coordinated sponsorship of these new local governments.

There was obvious and tacit abuse of this institution just as it happened between 1979-83. (Odoh, 2002). Such abuses came in form of varied and sometimes illegal deductions, and using the fund to sponsor party and electioneering activities. For a good number of States, it came to serve like a stabilization fund for the State government.

In terms of deductions, one or two examples can be cited. In one of the states of the North West, for example, the deductions were as follows:

2% for common services.
5% for emirate councils
3% for secretariat
1% for training fund.
2% to buy vehicles for local governments.
2% to buy Thuraya phones for all local governments.
2% to buy and maintain electricity transformers.

Items crept in and out when the need arose. It should be noted that the Statutory deductions are normally for Training, Pension and Common services.

Many States behaved similarly. In some other states, there were extra-budgetary impositions on local governments such as additional burden on the funding of secondary schools, central purchase of fertilizer on behalf of local governments, tractors and ALGON police vans, etc.

By the time these percentages are taken out of local government allocation, signs of stress on planned expenditures would begin to manifest.

One consequence of the abuse was the starving of local governments of the required funds with which to operate their normal budgetary expenditure. During the elections in particular, stories abound as to how state governments virtually restricted local government chief executive to payments of salaries only. With caretaker committees, local governments ceased to know how much they were entitled to from the Joint Account. In Kebbi State for example,

> the State Joint Local Government Account was controlled by the State Ministry of Finance and Economic Planning. The Ministry allocates monthly statutory allocations to each local government in the state without input from the Ministry for Local Government. So also, the local government councils were never involved in the sharing of these statutory allocations from the Federation Account. (Technical Committee Report, 2003).

This paints the ugly picture of how this account can be badly managed. This is also to buttress the fact that democratic leadership in local governments is of vital importance because it can ask questions and make the state agencies accountable on this Fund. Caretaker Committees were just appointed by the State as stop gap so they dared not ask questions about the quantum of money in the Account and the basis for allocation. This situation was a serious indictment on accountability and even devolution.

2.6.2.2 Internal Revenue Capacity of Local Government

During the period 1999 – 2003 the picture of low internal revenue effort of local governments (just like in other periods) had been the vogue. In an appraisal study, earlier referred to, (Technical Committee Report, 2003), it was discovered overall that local governments in all the 7 States of the North West geo-political zone, had not been able to raise 5% of their total revenue. Not more than two local governments were able to raise 10% of their revenue in any State. In Katsina State for example, the aggregate for four years (1999 – 2003) ranged from 0.44% in Sandamu to 3.2% in Charanchi Local Government Areas. This meant that over the 4 year period, no local government could, on the aggregate, raise more than 3.2% of its total revenue. One should then ask the basis for viability that could even encourage the wanton splitting of these units, if not for political purposes.

It must be pointed out that in that study, it was found out that Statutory allocation from Federation Account on the average contributed 93%, followed by VAT, then internal revenue, while statutory allocation from the state government took the rear and for some states, they never contributed at all.

2.6.2.3 Volume of Revenue

There is ample evidence to show that the volume of funds that have flowed into local governments during the period 1999 – 2003 was enormous. Speaking at the launching of the Global Campaign on Good Governance on April 10th 2001, President Olusegun Obasanjo, observed that inspite of the 400% increase in their monthly revenue in the last two years, local governments had failed to make the desired impact on their communities. He classified them as having failed. (NNN, April 11, 2001).

We can demonstrate this increase in volume of fund by looking at the mini case of three local governments in Gombe State, in the table below.

Table 2.5: Total Revenue of three local governments in Gombe State (1999 – 2001).

Local government	**1999 =N=m**	**2000 =N=m**	**2001 =N=m**
Gombe (Urban)	143.8	335.9	436.9
Akko (semi urban)	181.1	298.3	484.1
Billiri (Rural))	117.6	219.8	252.4

Source: Data collected from an Appraisal study, 2002.

There is apparent evidence of increases in the volume of funds for each local government irrespective of its classification. The greatest jump had been between 1999 to 2000 for Gombe and Billiri while for Akko local government, it is between 2000 – 2001. The allocation for Gombe between 1999 for example was more than 100% while other local governments recorded not less than 80%.

The cumulative picture of this for all local governments in the Federation is what the President referred to above. Indeed, such volume of allocation had evoked fundamental comments from the ***"Analysis"*** Magazine when it observed on three local governments from the East, North and Western part of the Federation thus: For example, in Abia State, the Aba South Local Government received the sum of N42,108,895.84 in January, N44,688,118.89 in February and N69,622,733.51 in March. This gives this local government council a total receipt of N156,419,747.77 in only three months from the Federation Account alone. This local government had less than 1000 staff on its payroll, assuming that the elected council appointed new staff. In fact, according to the ***Local Government Year Book, 1998,*** published by the Presidency, the Aba South Local Government had just 665 staff of all categories by 1998.

If we take another local government, Yola South, from Adamawa State, the picture was very similar. This local government received the sum of N27,097,084.98 in January, N28,898,721.36 in February and N45,681,488.82 in March. This gave this local government a total allocation of N101,677,295.16 in just three months. The staff on its payroll was 836 in 1998.

The Ajeromi Ifelodun of Lagos State is another good example to cite. This Local Government Council received from the Federation Account the sum of N67,561,452.34 in January 2002, N68,279,614.90 in February and N100,930,188.54 in March. This gave this local government council with a 1998 staff strength of 504, a total allocation of N236,771,255.28 in just three months. The question is what happened to this volume of money?

2.6.2.4 What have Local Governments done with the Money?

This is exactly the question the Technical Committee set up by the Federal Government on the Reform of the Structure of Local Government in the Federation (2003) was supposed to address. The issues of viability and efficiency were uppermost on the agenda.

. Addressing the nation on "the Need for Local Government Council Reform", President Obasanjo described the performance of local government as follows:

> ...what we have witnessed is the abysmal failure of the Local Government system. It is on record that at no time in the history of the country has there been the current level of funding accruing to the Local Governments from the Federation Account, yet the hope for rapid and sustained development has been a mirage as successive Councils have grossly under-performed in almost all the areas of their mandate. (Guardian Newspapers June 19, 2003).

This underperformance can be traced to both external and internal factors. Externally, the creation of more local governments and the increased clamour for more, constituted a large stress on local government funds. Internally, the available funds were used to "service bloated elected officials". In this connection, the President continued.

> Apart from the palpable mismanagement and misapplication of funds, currently witnessed in most Local Governments in the country, all the proposed new local government areas when created will share from the same revenue base available to the existing local government areas in each state. The resources available which otherwise should be used for development programs at the grassroots, are being used to service bloated elected officials and unproductive bureaucracies.

The external issues in non-performance have been addressed earlier on in this lecture. Let us highlight more of the internal issues. This flows from the comments on volume of revenue above.

2.6.2.5 Expenditure Patterns of Local Government

As the President rightly observed, a lot of local government funds went into expenditure on personnel. In a study carried out for the Technical Committee on the Review of Local Government, it was discovered that on the average, local governments spent more than 75% of their revenue on Recurrent expenditure while the

balance went into Capital. (The only exception to this was in States where there was standing policy directive as to what the formula for allocation to both expenditure heads should be. This we only found in one state). In some states, there were local governments that did not commit up to 10% of their revenue to capital expenditure. In Jigawa State for example, the figures of 2002 showed that 6 out of the 27 local governments did not commit up to 10% of their funds to capital expenditure.

There is however evidence to show that more money was allocated to capital vote between 1999 and 2001 when the elected leadership was on ground than in later part of 2002 – 2003 when leadership became appointive.

Even though local governments budget promoted more of recurrent expenditure, the content of this expenditure showed that 60% of this went to pay staff remuneration (personnel cost) while 40% went into overhead cost. In some states the ratio was as high as 55:45. What this suggests is that apart from committing much to salary payment, the maintenance or running costs in local government had been rather high and unacceptable. Perhaps one could say that monetization could be a panacea to such unbridled expenditures.

Furthermore when we look at Personnel cost closely, we discover that a huge part of this went into servicing what the President referred to as a "bloated elected official". We did some costing for a local government with 12 Councillors, a Chairman, Vice Chairman, 5 Supervisory Councillors, 6 Special Assistants, 5 Aides. Going by the average monthly salary of N110,000.00, the 30 political staff were to draw N39,600,000.00 per annum. This is outside allowances like constituency, vehicle and housing, security, which run into many more millions, all charged into personnel costs. When we consider the fact that the number of Councillors range from 10 – 16 per local government in some states, we would appreciate how much went into supporting these elected officials from local government coffers. This is not to overlook an area of expenditure like that on wives of chairmen and their projects. For the administrative staff, their ranks were swollen by wanton employment by politicians who did not want to respect recruitment procedures. So also the issue of ghost workers had been a threat to local funds.

2.6.2.6 Projects

Projects in local government are a fall out of capital expenditure allocation. Since capital vote of local government is low because of threats from recurrent expenditure, not very many viable projects are executed in local governments. Even with this low level capital funds, other threats like flouting of contract award procedures, shoddy implementation of projects and the role of the local party apparatus in contracting in local government, all work against the quality of such projects.

Nevertheless, local governments during this period undertook projects ranging from as low as N50,000 to N5 million with a few exceeding this unit. Projects ranged from minor works like construction of culverts and drainages to construction of roads and secretariat. There are also supplies, renovation and completion of existing/outstanding projects. Many of such projects roll from year to year so it is sometimes difficult to ascertain the exact cost on the ground. Projects are also sector based, like water supply in health, seed multiplication and tree planting in agriculture, building of mosques in social welfare and renovation of primary schools in primary and adult education.

There was however evidence that the cost of the project in a lot of cases far exceeded the worth of the project on the ground, a pointer to likely corruption.

2.7 Decentralization Beyond 2003

The story of decentralization beyond 2003 has not changed radically. The only thing is that sanity has been restored to the attempt to create new LGAs. Most of the States have reverted these decisions and labelled them as Development Areas. These Development Areas have been under-funded and not much is done to rescue them. Their type of subvention has not helped service delivery. What can an institution like a Development Area do with one million naira a month?

The initial turbulence that greeted the first 4 years of the fourth Republic in terms of the system of government/leadership at LG level has tapered. Each State now has a LG Law and the LG system has now settled and elaborating in these states. However, the core problems highlighted between 1999 – 2003 still remain while some of them are worsening. Conducting Elections into LG

Councils has become a problem for State Governments. In certain cases, legal actions are threatened or even taken before some states comply. Others only respond with intense public opinion and political pressure. A lot of the States are impevious and adamant as the seek to enjoy their leverage over the caretaker system. Where elections end up being conducted, in most cases, the party in power ends up controlling the entire local governments in its jurisdiction. Local Governments are still seen as providing political base for the state government rather than a development base.

The Constitutional provision on the Joint Account continue to threaten the existence of LGs, irrespective of whether LGs are democratically constituted or not. What ends up in LG coffers continues to fall short of what can run local government administration, capital expenditure apart. In my interaction with a Chairman recently, he informed that the amount that comes into the LG presently does not even suffice for sharing. Pointing at the population of visitors waiting to see him, he declared that that was just a sample. Normally at the end of the month, he sits down with his kitchen cabinet and 'shares' the money according to recurrent commitments of the LG, *meeting of needs (welfare) of visitors, taking care of his own staff, self and his colleagues.*

The cry over lack of autonomy and subsequent lack of productivity of LGs is rending the air, up to the National Conference currently going on in Abuja. State governments have not allowed any legislation to restore autonomy to LGs through the abolition of the Joint Account. The politics is on but the masses are suffering while LG is loosing face and image. Something drastic has to happen if LG should have a future in Nigeria.

2.8 Assessment of Development Performance (Service Delivery) of Nigerian LGs

Following from the theory of decentralization, devolution of powers (autonomy) engenders greater capacity for Service Delivery while deconcentration (control) lead to lesser capacity for service delivery. Devolution helps to build capacity and stimulate local initiative and decision making especially with democratized structures. Local Communities would be properly drawn into the decision making and planning process and local energies and resources would be properly mobilised. Deconcentration is largely

an institutional delegation of authority with strong centralising tendencies which threatens the transfer of power and authority to LGAs, and hence less tendency for service delivery.

2.8.1 Assessing Achievements or Performance

It is very difficult to put the achievements of local government in a prose form. There are however different ways of assessing achievements or physical performance.

One way is to look at the functional schedule of local government and measure to what extent each has been performed. Another way is to look at the plans of local government and assess them in terms of implementation according to the time frame and the projects.

Yet another way is to look at a local government capital budget and assess how much of the projects and services that are targeted have been implemented. One can also look at the chairman's annual address on achievements in his local government and get a feel of what the local government has been able to do. These are various sources and yardsticks, and many studies and evaluations carried out on local government's physical performances draw from these sources. The rest of this section comments on this and brings out some examples to support level of achievements.

In Nigeria the exclusive or mandatory functions of local government have lagged behind the concurrent functions. Remember the first function under the mandatory is planning. Local governments have not taken the issue of planning very seriously. They engage in perfunctory planning but they sooner or later jettison the document partly because of the instability in local government leadership. The incoming executive does not always believe in the efficacy or relevance of the plan he meets on the ground, so he avoids it. Some chief executives do not even believe in plans as they feel the straight-jackets of plans do not support their own objective or attitude to development.

The other mandatory functions which are largely revenue generating do not receive considerable attention either. Apart from markets and motor parks, community tax and collection of rates on shops, kiosks and business premises, the very lucrative ones like radio and television licensing and property rating do not appear to be exploited. Infact most local governments in rural areas rely on

markets as their major source of internal revenue. In the same vein, services like roads, naming of streets, street lighting, recreation, sanitation and burial grounds and cemeteries are not given the right priorities.

On the other hand, local governments concentrate on the concurrent functions of agriculture, health, and education where the tendency for expenditure is higher. They do not emphasize revenue generation because it is 'painful' exercise. They prefer to wait for the monthly grant from federation account to pay salaries and pay contractors for projects. Local governments do more of expending than generating. This is one of the biggest problems of local government in development today. When politicians campaign, nobody asks them about where they are going to get the money to deliver on their campaign promises. The answer is of course from the federation account. There is almost a zero initiative about transforming the rural economy in order to expand the wealth and tax base which in turn will provide adequate funds for local administration.

So, the vibrant departments in the local government are Primary Health Care, Education and until recently and Agriculture.

Primary Health Care is implementing the National Primary Health Care policy and therefore it receives additional funding or assistance from the federal and state governments and even international donors from time to time. In local governments, the UNICEF assisted programmes on capacity building and service delivery are evidences. The Bamako Initiative had also been a big project of the International agencies and the Federal Government. Local governments build rural health facilities, equip them and staff them. The problem has been the sustainability of the drug flow.

Primary education was hitherto a program of local governments but the National Primary Education Commission had taken them over. Remotely, local governments still control this because deduction of teachers' salaries is made at source from their account. This has thrown many local governments into indebtedness.(This is the source of the 'zero allocation' that has hunted LGs for sometime). The Commission built schools, so did local governments. Both bodies equip them. The local inspection and coordination however rests with the Local Authority Education

Committee of which the chairman of the local government is still the head.

Agriculture is not as vibrant as the other two sectors. Most of the activities associated with agriculture are fertilizer procurement and distribution, farm inputs, seed multiplication, tractor hiring and forestry. Serious moneys are not committed to this sector. Fertilizer appears to be the most vibrant activity in a lot of councils especially in the North. Animal husbandry is also an activity that is promoted. Tractor hiring is important especially for populations in the North because of the suitability of the land for mechanical ploughing. Donor Agencies including the World Bank have however lifted the face of Agriculture in LGs.

In terms of rural works, local governments can boast of attempts to provide trunk C roads, culverts, drains, building of markets, motor parks, small scale irrigation works, boreholes and wells, television viewing centres, staff houses, district head house, latrines and a few demonstration farms. These they do with great financial constraints and bad management practices.

2.8.1.1 Rating of Local Government Functions in the North (1977)

In 1977, a research was conducted into local governments' functions and how LGAs assess their performance in some Northern States.(Aliyu:1980)

The following table rates these functions as per the 1979 reforms and their performance.

Table 2 Functions reported to be one of the five receiving most importance by Local Governments: 1979 (N=138)

Function	Average rating by LGAs (%)ranked in top five
Education	88
Agricultural services	74
Collection of local taxes	61
Medical services	48
Rural and semi-urban water supply	46
Community development	33
Road construction and maintenance	31
Maintenance of law and order	28
Markets and motor vehicle parks	21

As pointed out in the general performance above, one can easily discover that the concurrent functions are high on the list. These are Education, Agriculture and Medical and health services. Collection of taxes was pursued then because community and cattle

taxes were still very viable sources of revenue and the statutory allocation factor had not yet been institutionalized in local government.

Note however, that a great percentage of the local governments rate the first three services high among the services they provide.

Other examples with service delivery are presented in the next part where I showcased some of my contributions to the subject matter.

Part III

My Other Major Intellectual Contributions to the Subject of Decentralization in Nigerian Local Government System

3.1 M.Sc. Thesis on "Impact of Oil Revenue on Local Government Finances (Odoh, A. 1983)

This study was done to find out the relationship between increasing oil revenue as projected by the Federation Account and the share of Local Government Revenue from this. Second, to find out whether the allocation to LGs increased their capacity to provide services. Third whether the dependence on oil revenue which dominated the external sources of LG revenue (statutory allocation) affected the local revenue efforts of local governments. The study found out that oil revenue had contributed immensely to financial allocations in LG even though the fluctuations in oil revenue was also noticeable in the flow and quantum of statutory allocation. Indeed the allocations were in a number of cases not regular and timely and therefore affected recurrent and capital activities of local government. Second, oil revenue created a lull over internal revenue efforts in LGs. This source was neglected because of over reliance on statutory allocation which created problems for financial autonomy in LGs. It was recommended that in order for LGs to feel derive sustainable benefits and impact from oil revenues, the following should be done:

i) Maintain the revenue allocation formula as it was but states should be made to contribute their share to LGs;
ii) Enlarge the internal revenue base of LG by introducing traditional areas of taxation and removing the primary education burden from LGs;
iii) Revolutionalise the present revenue allocation system to ensure better financial devolution in favour of LGs.

It would be recalled that eventually, the federal government policy on LGs, continued to review the revenue allocation formula in favour of LG and removed primary education from the direct management of LG.

3.2 The Future of Local Government in Nigeria (Odoh, A; 2001)

This was an essay in honour of the military and the development of local governments in Nigeria. The military had carried out various reforms on local government in Nigeria right from the experiment of Development Administration in Nigeria (deconcentration) to the famous 1976 Reforms of Local Government in Nigeria that not only divorced traditional political authority from Local Governments (thereby modernizing LGs) but also introduced uniformity and standardization in the structure and operations of LGs nationwide. They later-on provided for LGs for the first time in the Constitution (1999) set-up the Dasuki Committee in 1984 and Nwosu Committee in 1987 to propose reform in the LG system, conducted more elections in LG than the civilian administration, introduced the Presidential System of government into LG administration, reviewed revenue allocation to LGs, restructured the responsibilities for primary education, carried out administrative reforms to increase the capacity and autonomy of LGs, established the Joint Account, replaced and then reintroduced it. All these were in an effort to devolve more powers to LGs to operate. Knowing the antecedent of what happened under the Civilian administration of 1979 – 83 where elections could not be conducted into LG councils for those four years and where LGs were highly politicized, the paper could not but succumb to the nostalgia of the military exploits in LG and what laid ahead from a not-too convincing civilian administration's attitude to local governments. Our fears have been continually being confirmed up till the present.

3.3 Revenue Generation in Local Governments: Towards a Developmental Approach (Odoh, A; 2001)

This paper aimed at discovering and proposing ways to build the revenue capacity of local government to improve its level of financial autonomy to predispose it to better service delivery in the light of a lethargic approach to local revenue generation. The

principle of multipurpose finance which specifies the role of LG in the intergovernmental fiscal maze was used to understand the subject matter. The contribution of this paper laid in the prescribed developmental approach which emphasized planning, research, generation sources and strategies, investments and direct intervention in rural economies to expand the taxable resource base of communities and to make taxation more socially functional and attractive. All these must be structured within the right constitutional, legal and institutional framework for any appreciable success.

3.4 Assessment of Existing Human Resources for Supporting Development Action in Nigeria's Local Governments (Odoh, A. 2001)

Capacity for action depends on the resources available to LG. One of such critical resource is human capacity and the ability to use such capacity to mobilize other resource within the LG, the communities and other social capital to deliver services and improve management at the LGA level. This paper was an outcome of a UNDP study conducted in 1997 – 98 which generated empirical data from LGAs on their State of capacity for decision making management, service delivery. The findings point to the fact that the quality of staff rather than the quantity was the problem with LG. As a result, quality decisions and their implementation suffered from such deficient manpower. Conspicuous gender gap was noticeable in the staffing of senior staff of LG especially in the decision making units and levels. More of women staff were in education and health. It was recommended that this gap should be systematically bridged as more qualified females should be encouraged to join other units. That for a more effective human resource and institutional development, capacity building at the LG level would have to target such areas of capacity needs rather than the usual uncoordinated training that goes on from time to time.

3.5 Federal Financing of Local Government in Nigeria: Trends and Prospects (Odoh, A; 2002)

This paper reviewed the trends in federal financing of LG from grants in the mid seventies and then statutory allocation from the eighties. This contribution to LG finances had varied from 60%

to as much as 95% in terms of FG total share of LG total revenue. Primary Education had threatened LG finances over time consuming on the average 80% of total LG funds. The FG devised various ways of dealing with this issue in such a way that this burden would be reduced in order to free resources for other developmental functions. The dominant role of federal government in the financing LGs had created a lackadaisical attitude on the part of States and LG to their own financial obligations to the institution. With the noise over true federalism, the prospect of the federal government continuing with the same momentum was becoming unrealistic. The States should be ready to assume full responsibility for its LGs and consider federal intervention in LG finances as more of a constitutional requirement rather than the political strategy during the military. Devolution will not be meaningful if the momentum is not maintained.

3.6 Local Government Autonomy since 1985: Trends and Problems (Odoh, A; 2004)

This paper took off from the premise that autonomy is a pre-requisite for effective decentralization. It addressed the issue of LG autonomy and its vicissitudes over time employing variables like administrative control, finance and democratic bases as basis for analysis. The paper employed quantitative and qualitative data to demonstrate that LGs ironically enjoyed greater autonomy under the military than civilian administration especially between 1988 and 1993. The multiple reforms under the Babangida administration promoted this, compared to what was presently experienced from 1999, and there was the genuine fear that given the trends of event under the Fourth Republic, a bleak future was a very likely possibility because the paper discovered that whatever autonomy the military left behind was being eroded constitutionally and politically.

3.7 The State Joint Local Government Account: A Viable Mechanism for Fund Allocation! (Odoh, A; 2002)

The State Joint Local Government Account (SJLGA) is a constitutional provision that pooled all statutory allocation to LGs. Such funds were channelled through such Account to each LG. It had its problems in the Second Republic when it was first tried. The military had to suspend the arrangement when they took over power

and at a point introduced "direct funding" into each Unit LG funded direct from the Federation Account. This was a response to massive interference by States in this Account. The Joint Account was hurriedly introduced into the 1999 Constitution at the exit of the military which analyst said as a disservice to effective financial devolution. The paper discovered that the Account was a disservice to LG autonomy and service delivery mechanism. It had become a political instrument and not a viable mechanism for fund allocation. The options were either to modify the Joint Account to bring in better checks against its abuse or resort to the option of direct funding.

3.8 Local Government and Democracy in Nigeria (Odoh, A; 2004)

The paper was premised on the fact that for LGs to experience meaningful devolution the democratic content and context of this institution would have to be emphasized. Reviewing democracy in LGs right from colonial times through the post independence era, the paper discovered that the democratic content of LGs improved in the post independence era. However, the military encouraged greater democratization in LGs than the civilians through series of reforms and the more numerous elections conducted for LGAs. The paper recommended that there was need for better political will and commitment and a constitutional review to support greater devolution in LGA, if democracy was to support greater devolution and improved services.

3.9 The Place of Research in Local Government (Odoh, A; 2004)

The paper highlighted the importance of research generally and in government. It however, noticed the low level of research orientation and activity in local government. This is moreso that the 1988 Reform of the Local Government Service introduced Planning, Research and Statistics as a unit in Local Government. The paper detailed out the importance of research and the areas of research in LG (part of which is effective planning and services in local government). The paper discovered that part of the reasons for low research orientation were attitude of leadership of LGs and the capacity and competence of staff to undertake such and the funding

support attendant to it. The agenda for research is myriad and there is the need for extensive research if LGs are to perform their planning, management and service delivery functions.

3.10 Local Government and the 1999 Constitution (Odoh, A; 2003)

This paper identified the areas of focus on LGs in terms of constitutional provisions on LG. This accommodated issues of establishment, the third tier status, boundary adjustment, and LG creation, funding and intergovernmental fiscal relations, elections and the schedules that listed the names of LGs per State and the functions of LGs. On the face value, the third tier status of LG which ought to have guaranteed effective delegation was guaranteed. The major disservice of the Constitution was the retention of the SJLGA which was a virus to destroy all the gains of LGs over the years and the third tier guaranteed by the Constitution.

3.11 Two books resulting from National Conferences on Local Government in the eighties were co-edited by this author. They were (Odoh, A; & Oyeyipo F. 1984) Local Government as Vehicle for National Development and (Odoh, A; & Oyeyipo, E; 1986).Government at the Grassroots Level in Nigeria

Both books contain articles on pertinent issues in Local Government administration and specifically addressed issues relating to the institution of local government, its historical review, issues of the structure, functions autonomy and control of LGs, funding, human capacity building and manpower development, traditional political institutions, community development and mobilization and service delivery. These address broadly issues of decentralization and service delivery. These books have provided a lot of reference materials to scholars and even this author especially during his Ph.D research. The materials therefrom are the disposal of my students and beyond. The Federal Government had used the outcomes of such conferences to influence, modify or change policies.

3.12 How Local Governments operate in other Countries (Odoh, 1987)

This Mimeo compared the workings of local governments including the issue of decentralization in some federal and unitary systems of the world. They include the United States of America, Britain, France, Japan, China, India, Tanzania and Nigeria. It found out that for the advanced countries, irrespective of the level of decentralization, democracy had contributed to service delivery. There was high level of capacity, high level of efficiency, well funded local councils and efficient service delivery. Such LGs were highly accountable. The Indian situation also showed fairly good example of devolution as village, district and local government level. Administration operated with adequate democratization accountability and service delivery. Tanzania showed situation within an LDC where ideology and local democracy governed the success of decentralization at the local level. Once the ideology started faltering, local democracy was impaired and so grassroots mobilization and development suffered. Nigeria, irrespective of constitutional provisions and institutional and political reforms, has not been able to experience any meaningful devolution and development at the local level.

3.13 Research Findings on the Capacity for Service Delivery in Nigerian Local Governments (Odoh, A. 1991)

One would have expected that with the theoretical premise that local governments' service delivery role ought to have flourished more under democratically constituted local governments than non democratic ones, we expected LGs to have performed better under the civilian administration than the military. Our findings over the years have shown to the contrary. First that devolution did not show any marked advantage over deconcentration in service delivery in Nigeria LGs. Second, that under the military run LGs with inconsistent autonomy, service delivery had more prospect under the military than civilian administration. Third, was a stunning finding that people preferred non-partisan politics (as in the military) to partisan politics (as in civilian administration) especially at the grassroots level. These findings/positions are contained in two papers/studies carried out by this author. The findings came out of a study conducted by the three

Universities responsible for training LG staff in Nigeria (OAU, UNN and ABU) in partnership with the University of Bourdeaux, France, 1988 – 1990:

The first paper titled "Local Government, Party Politics and Political Regimes" (Odoh: 1990) sought to examine the influence of party politics and regime types in the workings of LG structures in Nigeria. Findings were based on a survey research cutting across the geopolitics of the country and the findings were as follows:

a) in most of the regions and especially in the North the local authority became an institutional arm of the party in power to the extent that majority of party members became paid officials of Local Governments. Such politicization affected even routine LG decisions such as staff appointments which came to carry party colorations.

b) Local Governments were used according to Gboyega (1987) as an instrument of coercing political support.

c) The preoccupation of LG had been with political survival rather than service delivery under civilian administration

Responses from LG Officials

Results from the analysis from the point of view of LG officials show that:

a) Local Governments better deliver goods and services under the military than civilian administration (77 – 90% against 18.4%). Breakdown shows that the distribution was 71.5% agreement in the East, 87.9% in the West and 77.8% in the North.

b) Party politics had not raised the standard of administration in local governments compared to the military. (This was confirmed by a general opinion of 75.4%. The East recorded the highest vehemence of 80%, followed by 75.8% in the West and then the North, 71.9%).

c) Party politics is innocuous to LG and so should be kept out of LGs and restricted to higher governments. (At a general level, 62% of the whole respondents subscribed to the claim while responses from the East, West and the North show 77.1%, 54.5% and 58% respectively).

These responses showed that there was something fundamentally wrong with civilian regime and LGs. The politicisation of the institution had not allowed for effective decentralisation and largely saw the institution as an instrument of political control rather than service delivery.

The People

The people were asked to identify when they experienced more peace in their locality. 70.1% pointed out that military regimes provided more peace, confirmed by 73.3% in the North, 72.9% in the East and 57.6% in the West.

The other issue for the people was whether better performance of LG would result if councils were democratically constituted rather than a system of Management Committees. People were generally positive toward this, affirming this with 67%. When asked the method of fostering such democracy, the people frowned at party politics as a credible means. 58% of the people expressed their disdain for party politics with the strongest resentment coming from the East with 69.8%. The North followed with 55.3% while the West recorded the least resentment with 41.8%. For the opinions against party politics, the key reasons given was that party politics had been highly conflictual and divisive, followed by "worse leadership/performance," corruption and then victimization. They claimed that it was the divisive factor that slowed down development at the local level.

In another paper from the same study, titled "Perceptions Attitudes and Behaviours of Local Government Officials toward the People in Nigeria, the following conclusions were reached:

a) Local governments were survivalist institutions than mobilisation oriented. Most of their attention were directed on how to survive as an institution rather than directing their energies for community mobilization and developments.

b) More than half of the work of LG officials is restricted to the office and for the senior ones, trips to headquarters and other such engagements. Where they attempted to meet with communities, they only did so with their representatives, which was even rare.

c) LG officials still believed that the LG bureaucracy remains the most competent instrument to handle rural development

rather than through community based group – a firm belief in the top-down approach.

d) People are more involved in LG administration at the level of payment tax and other revenues and some support for community development. They are less visible when it comes to the democratic process and decision making at the local government level. This shows that LGs have been more extractive than distributive in their administration and no wonder the dearth of service and lack of trust for the institution at the LG level (Odoh: 1990).

All these point to weak devolution, weak democratic practices, weak capacity, low level of autonomy and a weak propensity to provide services. The issues here when weighed against their level of financial devolution warn us about expecting much in the area of service delivery from LGs.

Part IV

Towards Effective Decentralization For Development: (Current Thinking)

As an expert on Local Government for the World Bank assisted Fadama Project in Nigeria, there is a new thinking on engendering development at the Local Government level.

The thesis here is that decentralization should not stop at the official local government level. It must formally incorporate communities into the power sharing process. As things stand, communities are alienated from their LGAs, politically, socially and economically. Local governments are neither playing their political roles nor their socio-economic roles properly Communities are made to look like liabilities, while there is so much resource and energy in these communities. If LGs do not have capacity to harness them, communities and community based organizations can harness these by themselves. If LGs do not have the capacity, their capacities can be built by other partners in local development together with those of the communities. In this way LGs would have acquired the needed capacity coupled with whatever level of autonomy they enjoy to be able to deliver services. The closest they have come to support communities has been through Community Development (CD) but this has not been well organized and managed. Even their resource level has not encouraged them to provide this support in any meaningful way. Besides, their approach to CD had been largely top-down and does not allow for serious local community initiatives in needs assessments, and participatory planning and development, so, communities end up not learning much from the process. Direct Services provided by LGs to their communities and indeed projects have not been sustainable because no sooner are they delivered than they become non functional. LGs do not have eyes for sustainability and this is why their capacities must be built to realize that it is in their interest that development should not just be top down but bottom up. In this case, the bottom up refers to an upgrading of the CD approach to the contemporary approach of Community Driven Development (CDD). The imperative of this is that both communities and local governments need to be empowered and will

require transfer of powers to not just local governments but further devolution to communities. CDD then becomes an effective panacea for the fledgling decentralization in Nigerian LGs.

4.1 The Concept of CDD

CDD is community driven development. CD is Community Development. The truth is that CD is a Local Government way of relating with community even though by definition it is "the process by which the efforts of the people themselves are united with those of governmental authorities to improve the economic, social and cultural conditions of communities, to integrate these communities into the life of the nation and to enable them to contribute fully to national progress." (Maddick 1963:23). It only emphasizes inputs with little attention to needs identification and community planning and supervision. The concepts of ownership, functionality and sustainability are not built into these. LGs just support community project demands with little or no follow up. This is top-down.

CDD on the other hand is a new vision of enabling people to take their destiny into their hands. It is an approach that puts the community in the driver's seat of development. Communities set their agenda for their own development. Communities can take control over project decisions including management of investment decisions. (World Bank; 2002).

In addition, CDD is

i) a key to provide social and infrastructure services to organize economic activities and resource management to empower people to improve governance and to enhance security of the poorest.

ii) a mechanism for enhancing sustainability, improve efficiency and effectiveness and targets poverty reduction.

iii) CDD encourages partnership with demand-responsive support agencies and service providers.

CDD has become necessary because

i) billions of dollars in the aid of LDCs development mostly channelled through government and some NGOs have not produced results.

ii) World Bank Evaluation has shown that projects with community participation have succeeded.

iii) Evidence from Donors and NGOs also show that when the poor are empowered with resources and voice, it leads to sustainable development.

iv) In a study carried out by Narayan (2000) two key findings that emerged among others were the poor wants Organizations of their own so they can negotiate with government; Direct assistance through community-driven programmes so they can shape their own destinies.

v) CDD empowers people, expand people's freedoms, devolves control and decision making to the poor, gives voice to the excluded such as girls, women and children.

From the definitions and rationale for CDD, it is evident that these types of ideas, proposition, approaches and targets are a direct indictment on the activities of governments and especially LGs on their philosophy and approach to development and the inability of these institutions to reach the people with services talkless of identifying and meeting the needs of the poor and vulnerable. The strategy here wants to relate directly to the community through devolving powers and funds, organization, planning and management to local communities. CDD targets community empowerment because once communities are empowered, it takes away the pressures from LGs. With minimum support from LGs. the system of devolution would become more meaningful because services would reach communities and poverty would reduce. Democracy and governance would also start taking root with local communities. This is then the real essence of devolution.

CDD rests on five pillars viz: Empowering Communities, Empowering Local Governments, Realigning Central Government Functions, Improving Accountability and Capacity Building (learning by doing).

The first two require some explanation.

Community empowerment involves expansion of assets and capabilities of poor people to participate so as to control and hold accountable institutions that affect their lives. Communities can do their own needs analysis and plan their development and even seek

for funding support. Empowerment is about participation, funding and social inclusion.

Empowering LGs would require LG to provide the institutional framework (political, administrative and financial decentralization) in line with the principle of subsidiarity. Decentralization would make LGs more autonomous, viable and more responsible, having powers to act and taking charge of the development process. Local government's capacity in community mobilisation and participation methods and project management are enhanced.

CDD therefore seeks to make decentralization more meaningful in local government and hence increase governance and service delivery. This is what LGs have failed to do for as many years as they have existed. It is strongly felt that CDD can add value to effective decentralization at the local and community levels. It may also be necessary for some legal and policy constraints that work against the CDD in LG be removed or relaxed. This is policy related and such impact will have to be agreed by higher governments. There is need to step down this discussion to the practical level.

4.2 Examples of CDD Project

CDD is not just theory. The practice has demonstrated visible and fantastic results where it has been used. Examples of CDD Projects in Nigeria are largely associated with World Bank Projects. The most widely known has been the Fadama Projects especially the Second and Third National Fadama Projects; the Local Empowerment and Environmental Management Projects (LEEMP) the Community Based Poverty Reduction Project, and the Community and Social Development Project (CSDP). Other agencies like the UNDP and UNICEF have adopted the CDC approach. Perhaps it is useful to give an example with Fadama III project in order to illustrate the importance of CDD in the decentralization process.

4.3 Example of the Fadama III Project

The aim of Fadama III was to sustainably increase the incomes of the users of rural land and water resources. The partners on the Fadama III were the World Bank, Federal Government, State

Government and Local Government and Community. A memorandum of understanding was signed by the Bank and the Governments which committed each stakeholder to various responsibilities including cost sharing.

Structures of the Fadama Project were established at the National, State, Local Government and Community levels. At the National and State levels, they had coordinating offices while at the local government level, two structures, one for coordination (Local Fadama Desk Office) and the other (Local Fadama Development Committee) for approving Local Development Plans (LDPs) were established. The Head of Agriculture Department or his representative headed LFDO (as Desk Officer) while the Chairman of the LG headed the LFDC respectively.

At the community level, two structures were put in place; the Fadama User Group (FUG) and the Fadama Community Association (FCA). These groups were trained by the Project and assisted by a trained Facilitator to undertake a community needs assessment and based on that, prepare a Local Development Plan (LDP) to be funded by the Project. The LG was to ensure the screening of the LDPs (by LFDO) and the approval of the LDPs (LFDC) to ensure that they are sound, feasible, environmentally sustainable and do not conflict with LG plans. Thereafter the LDPs moved to the State level and the National and or approval, funds are released direct to the accounts of the FCAs and FUGs for implementation. At this stage the States and Local Governments preside over the release of cheques to the various groups. The Project ensures that the groups manage the funds themselves without interference. Both States and LGs do not interfere in their funding – they are not even signatories. Communities drive the process themselves and these monies are spent in areas such as implementation of their plans which could involve:

i. Small Scale Community owned infrastructures e.g. borehole and roads and irrigation, market stalls etc.
ii. Advisory services and input support (from registered consultants).
iii. Asset acquisition for individual FUGs and Economic Interest Groups (EIGs) e.g. garri processing machines, rice milling machines, palm oil processing, etc.
iv. Project management and monitoring.

Training and Capacity Building (CB) is done for community groups and at the local and state government levels so as to equip the staff with the capacity to understand the project and its requirements and effectively guide community groups in project planning, implementation, monitoring and evaluation in addition to project management skills. Specific training is also given in this agriculture, infrastructure and financial management and record keeping matters.

The commitment of LGAs apart from LDP approval is funding support. LGs are supposed to contribute N1m per annum as counterpart fund for running the LFDO and LFDC and supervising and monitoring visits to subprojects at community level. LGs are supposed to mainstream the Fadama subprojects into their plans and use the CDD approach to implement such plans. They were also, at the end of the fadama project required to take over the support for Rural Infrastructures created by the Project in the community. The World Bank and the National and State Coordination Offices organise supervision missions from time to time apart from their own Project Management and Monitoring Reports. These supervision visits to subprojects in the States and Local Governments have provided opportunity to assess the progress of the Fadama Project and have disclosed abundant cases of project successes and beneficiary satisfaction. Such visits have also highlighted problem areas while Action Plans are developed to address such problems. (National Fadama Coordination Office Report, 2002).

In the above Mid Term Report it details out a long list of "Summary of achievements in terms of FCAs and FUGs registered, trained, (range 52 – 55%). In terms of LDPs 50% were prepared, 87% approved, 27.5% fully implemented (at midterm) 72.5% ongoing. In terms of subprojects, 43.9% completed, 23.4% ongoing. For asset acquisition, 23.7% of FUGs acquired asset (i.e. 13,673 FUGs). For savings account, N115,414,952 had been mobilised into Fadama User Equity Fund (FUEF) Accounts nationwide. In terms of training for LG staff, 1,966 LGA staff were trained (65.5%). Note that at this midterm, 55.5% of Fadama fund had yet been disbursed nationwide.

In terms of outcome indicators, the following happened

i. Income of participatory Households: 75% of Fadama User households who benefit directly from project-supported activities have increased their average real incomes by at least 40% by 2013.

ii. Yields of primary agricultural products of participatory households increase by 20%.

On some of the supervision missions which I was opportuned to participate, in, the team was always able to verify the operations, maintenance and utilization of assets, infrastructures, farmlands, records and reports and group dynamics at community levels. These were very satisfactory and producing results. State Reports also confirm these. Communities were found to be in control of their projects. Infact fadama became the swansong of Community members including women FUGs. They claim they know no other government than Fadama or the World Bank, even though the World Bank would insist that the Fadama Project was only WB assisted. **Some claimed that it was in the era of Fadama that they started seeing LG officials in their community.** As part of their testimony a group from Song LG of Adamawa State, claimed that the Fadama had impacted on their members. With proceeds from their subproject, some members of their group had performed holy pilgrimage, some bought motor cycles and two bought buses for transportation and they had added two classroom blocks to their primary school. The story is replete in many communities.

Local government capacities have been built with regards to their personnel and the institution itself. Each LG is equipped with a set of generator and ICT facilities to be used for project purpose. In many of these LGs Project equipment were often borrowed to service LGs own activities. The LFDO appears to have developed a unique work ethic and better organised than the other officers in the LG.

Accountability is promoted in project management as the Desk Officer had to always account for monies release to it periodically before new administrative funding requests are made. In the same way, community groups need to account for subproject funds released to them in tranches, before the next tranche is

released. At the community level, meetings are held by FUGs from time to time to discuss project implementation and outcomes – a sort of feedback and accountability exercise. This is the idea of improved governance and social accountability at the Community and LG levels as part of the Principles of CDD.

So CDD and Fadama have promoted development at the local government at Community levels not just by introducing agriculture and social and economic development project as requested for and managed by communities, but has improved governance, responsiveness, responsibility and accountability at both levels. Where LGs can adopt such methodology in their approach to rural and community development, adequate capacity would have been built at the community level, which can also multiply and spread among community members. Communities would have been ready to take up more functions from LG and LGs would have been empowered to guide communities with more economical use of resources and opening communities to other sources of credit, including development partners. This is the true decentralization for development. With community empowerment, community participation in politics will also increase and their voices will be heard. As a result they will be able to demand for services and hold their representatives accountable. This is decentralization and democracy for development – a huge leap in paradigm.

1.0 Conclusion

Mr Chairman, this Inaugural lecture has helped to unveil the fact that the Nigerian local government system paints a picture of decentralization, democracy and development rather than decentralization and democracy for development. We have found out that Local Governments under the military made more progress than under civil rule and that the military ensured greater democratic and financial devolution and development than the civilians. The explanation of this hinges on the political objectives of the two institutions. While the political objective of the civilian regime for LG is to protect their electoral gains and use LG as a reward system, that of the military was to gain legitimacy through the populist policy of allowing greater devolution for services at the LG level. The military needed the support of the people for continued military

rule so they were more liberally disposed to the institution of LG which they felt could accomplish this aim. Civilian regimes need LGs for political control and hegemony especially against the opposition and also for patronage for its teaming sympathisers. That is why sometimes party officials and hangers on find their names on the payment vouchers of LGs and heavy political colorations are given to policies and their benefits at the LGA level.

The problem with decentralization is that it is a myth in the Nigerian LG system. Whether deconcentration or devolution, and irrespective of the constitutional guarantees of 1979 and 1999 Constitutions, local governments have ended up the worse because the political objectives of the implementers, especially the state government is in contradistinction to constitutional provisions. Therefore the States have stoutly stood against the idea of abolishing the State Joint Local Government Account even though they realise that passing resources directly to LGs would expand their capacity and propensity to implement projects and deliver services. This would in turn empower communities who in turn will become better mobilised, translating into political empowerment. As pointed out, this does not suit the political interest of the ruling class.

States must be ready to assume their authority over local governments in a more positive way. Section 7 of the Constitution hands over local governments to the States. This implies that if LGs have failed, then the state government is to blame. If any State Chief Executive genuinely wants LGs in his state to work, the LGs have no business thwarting his objectives, given the political structure, source of political power, and the partisan basis for regulating such power in the state.

It is not a matter of two forces working against LG autonomy and responsibility, namely state interference, and abuse of power by LG political and career staff. Abuse of power cannot take place if the state performs its supervisory and monitoring roles of LGs properly. On the other hand, interference cannot take place if the state genuinely considers LG as an instrument of development. Head or tail, the State holds the ace. The preconceived idea of LGs' low capacity and predatory attitude does not help matters. What would help matters is for the State to purge itself of such perception and take a bold decision to restructure, reorganise its local governments with some bold political will. The interest of the State political elites

and the LG political elites should not continue to be united for the wrong purpose – running down the Institution of LG. Their attitude should be united in building the institution for democracy and development. Such dividends of democracy provides a more credible basis of political control and sustainability than a top-down politics. The CDD approach is an eye opener on how, with little assistance to community groups, multiple centres of growth and development can be orchestrated. Local governments capacity needs to be built together with the right legislative and administrative frameworks to harness donor experiments in communities, which has yielded lots of dividends in such communities.

Decentralization can only be meaningful if democracy and development are decentralized to the communities thereby empowering communities to take up greater responsibilities for their development. This is the paradigm shift that is desirable, workable and can promote sustainability. This is the agenda for LG in the foreseeable future if the image of LG and the State is to appreciate.

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Chapter Seven

Revealing Six Decades of Zaria Art School Treasures

Revealing Six Decades of Zaria Art School Treasures

Jacob Jari
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Wednesday, ll'th June, 2014



Jacob Jari
Professor of Fine Art

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Introduction

2014 marks 59 years of the existence of the Department of Fine Arts in Zaria; first in the Nigeria College of Arts, Science and Technology and subsequently in 1962, as one of the few founding departments of the Ahmadu Bello University. Since the 1960s, writers like Beier (1960) had begun to refer to the department as the Zaria Art School because of the influence it continued to exert on art practice in the country. Mount (1973), Fosu (1986) and Oloidi (1998), to sample a few authors, have maintained the reference to the department as an art school. In 1990, the National Council for Arts and Culture recognized the status of the department as a school of art by featuring the works of staff and students of the department in an exhibition the council titled, *Zaria Art School*. This is followed by a voluminous publication by the National Gallery of Art in 2009 entitled, *Zaria Art School*. Location does not determine a school of art. It is determined by the expression of artists who share a common style, opinion or idea. It is therefore, possible to have the same school of art in different art institutions. It has been insinuated by Okeke (1995) and Ogbechie (2002) for instance, that the Zaria School of Art is practiced in art departments located in the University of Nigeria, Nsukka, the University of Benin, Benin and the Obafemi Awolowo University, Ife. The ideas of the Zaria Art School were exported and entrenched by early graduates who included, Uche Okeke, Irene Wangboje and J.R.O. Ojo.

Despite this monumental achievement, a few people including academics from other disciplines far younger in establishment than the Department of Fine Arts in Ahmadu Bello University have difficulty in evaluating the worth of the Zaria Art School. Several incidents point to this fact, one of the most bizarre of which occurred in 2006 when the dean of a faculty declared at a meeting that until that day, he did not know that Fine Arts was offered at tertiary level! At most lectures, which I have delivered on the demeaning status of art in Nigerian Society, I have always traced its roots to tradition. I have occasionally referred to Schwerdtfeger (2007) where it is reported that the initial respect given to an artist eventually and ironically turns to a fatal disdain. He reports that the title, *gwani*, is the highest honour Hausa society, not its rulers, can

give to an artist with exceptional skills. He claims that in the past 200 years only six builders had been bestowed that title. One of them was *Baban Gwani* Muhammadu Mukhaila Dugura who was killed around 1852 for building one of the most magnificent edifices of all time in Zaria, the great Zaria City mosque.

I have also referred to the strange conferment of the hero status on Okonkwo, rather than his father, Unoka, in Chinua Achebe's classical book, *Things Fall Apart*. The book opens with the comparison of Okonkwo to his father, Unoka, one of the greatest musicians in the land who by inference was an artist. Okonkwo is described as a violent man, emotionless, wealthy farmer and a title-holder while his father is described as a debtor, weakling and a fiddler. I have read this book several times and to this day, I am unable to understand why Unoka is so contemptuously described other than the fact that he was an artist. Let us examine the manner in which he is presented in the book.

We meet him right at the beginning of the story when we are told that Okonkwo had no patience with him because he was an unsuccessful man. He is described as lazy and a spendthrift, two contestable descriptions since, when we read the story further, we would establish that he could play music for several days on end, hardly a feat for a lazy man. The reason why he was a debtor was because although people liked his music a lot, he was not commensurately compensated for it. The other reason why he was a debtor was because he was very generous. Unoka liked nature; he liked a tranquil landscape with children playing and birds flying. He hated wars and could not stand the sight of blood. His son Okonkwo, on the other hand, loved fighting wars at which he had already killed several enemies, using the skull of one of them to take his palm wine. How could such a peaceful, creative, generous but underpaid man as Unoka be detested and preference given to a stone-cold killer whose preoccupation was to spread sadness everywhere he went as Okonkwo?

The introduction of Okoye, Unoka's friend as a direct opposite to him although they were both musicians only serves to illustrate rather, that as an artist, one needed to take another job to be successful in traditional Nigerian society. Okoye played the *ogene* but he was also a wealthy farmer who had three wives, two titles and a lot of food. To this day, many Nigerian artists have had to take

other jobs such as teaching in order to stay alive, and presently, art and artists in Nigeria sometimes suffer debasing branding as Unoka did. Reference to only recent accounts would suffice. Soyinka (2006) reports that in 2006, a group, the United Congress of Mbaise Christians, destroyed over 100 shrines with all artifacts contained in them. In 2007, a public sculpture in the city centre in Jos was destroyed purportedly under the orders of the governor, Jonah Jang. In the same year, it was reported that Governor Sylvia Timipire of Bayelsa State proscribed the teaching of art in public schools in the state.

Testimonial

These forms of iconoclasm have shaped my artistic expression over the years. I find that I have a strong affiliation to rejects; things found to have no use and are discarded. I see myself in them, knowing that they and I suffer the same fate as we are misunderstood by society. I imbibe Conceptual Art as a mode of expression, a post modernist approach which puts premium on idea over medium and technique.

The first discarded material I employed was cornstalk, in 1988. Most farmers discard cornstalk in farms after harvest. It is sometimes fetched and used as fuel for cooking or for feeding animals. It could also be used as fence to houses or for roofing but largely, it is abandoned after harvest and sometimes burnt on the farm in preparation for the next farming season. I find great joy revisiting the farms to conduct what I term a second harvest, fetching the cornstalk for my work. I bring it to the studio, peel and slice it into different shapes of interest. I lay my support, which is usually a board, on the floor and use water to splash on it, which creates a pattern. I mark out this pattern and allow the board to dry after which I splash another cup of water to create an overlapping pattern over the first one. This act of splashing is symbolic of chaos caused by the rejection earlier referred to. I work out my design, deciding and marking out which colours to use for each part of the patterns created on board. I then colour my pieces of cornstalk according to the chosen colours using diluted artists' oil colours. When they become dry, I stick them to the board following the dictates of the patterns and the design I worked out earlier. I usually use primary colours for the patterns and where there is an overlap, I

use the secondary colour, which results from the mixture of the two primary colours, which overlap each other. The coloured pieces of cornstalk represent the different people who are required to come together to salvage a chaotic situation created by the neglect of their relevance. Plate I shows one of the works I produced using cornstalk.

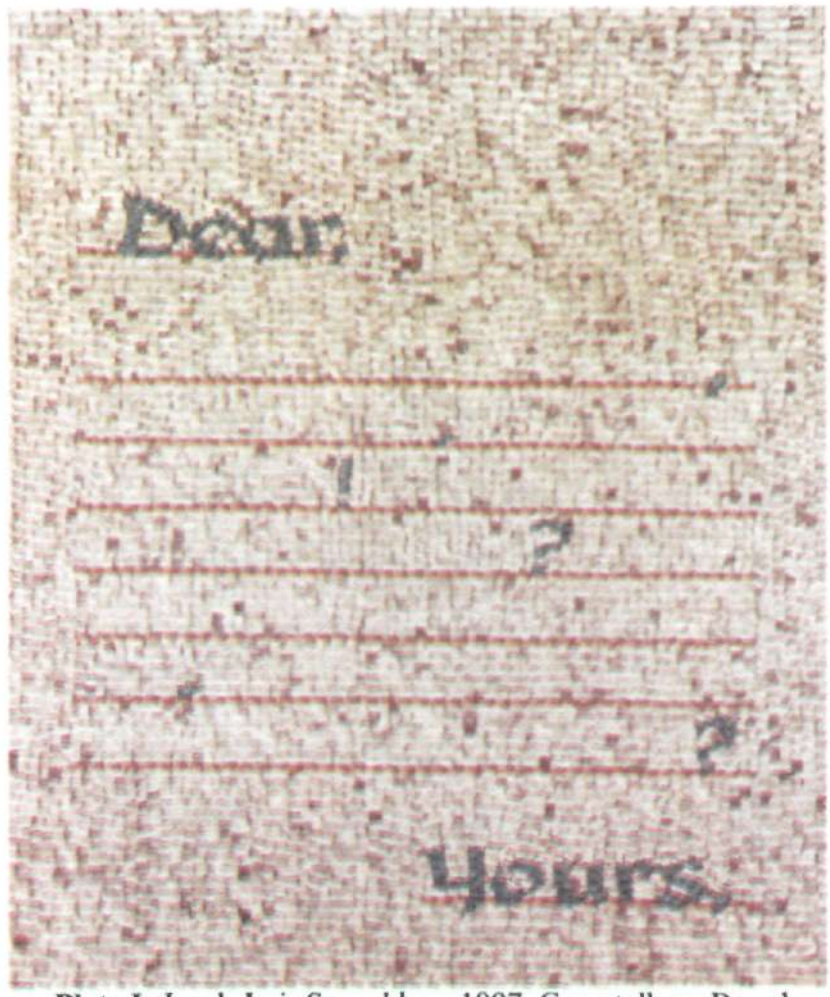


Plate I: Jacob Jari, *Speechless*, 1997, Cornstalk on Board, 3' x 2'

Apart from cornstalk, the other medium I use is the off-cut fabric discarded by tailors.

The fabric we give the tailors to sew for us is usually carefully selected from the market to agree with our aesthetic taste

and disposition. It becomes symbolic of us. We therefore, necessarily leave pieces of us behind with the tailors after we have collected our clothes since they usually cut off the unwanted parts of the fabric in order to shape our clothes to fit us. These off-cuts are eventually discarded by the tailors and often burnt. Again, like in the case of the discarded cornstalk, I visit the tailors to perform a second harvest of collecting the pieces of discarded fabric to create my work. These pieces of fabric, like me, have been rejected by society. This rejection is dramatized in the perforation exercise, which I perform with red-hot metal rods on my support, this time, canvas. The usefulness of the rejected off-cuts of fabric is seen in their coming together to seal the perforations and the transformation of the canvas into an aesthetically pleasing whole.



Plate II: Jacob Jari, *The Hunt*, 2012, Mixed Media on Canvas, 88.9 x 119.4cm

Plate II shows *The Hunt*, a work I created with the discarded pieces of off-cut fabric. Usually, in this type of work, I try to create three dimensions on a plain surface. The image of the perforated canvas is one dimension, the image of the canvas with the stuck pieces of fabric is another dimension and the visible silhouetted

forms I embellished on the support is the third dimension. The technique reechoes the function of glass. When we look into glass, we see the specks of particles, which have settled on it, we see our reflection and we see objects on the other side of the glass. Looking into glass for me is metaphorical. The holier-than-thou in society ought to see themselves reflected when they look into it. When we refer to people as degenerates, we ought to see that we live in the same glass house and we should not throw stones.

A third medium, which I use in my expression, is discarded printed news magazine. A current and topical magazine in the course of time becomes stale and is abandoned by the reader. When it is discarded it identifies with me, an artist, who is misunderstood by society. I pick it up and strip the pages to create tiny capsules, which I use to create my work. I usually stick the capsules unto a board. When stuck to the board, they appear to come alive like tiny crawling insects on the support. My objective with this type of work is to create tension on the support. A viewer would therefore, see that there is a main current which the capsules try to follow. Not all of them succeed in flowing with this main current and so there is a seeming struggle to be sucked into it. Plate III illustrates this. I titled the work, *Eclipse*, a short version of the full title, *Eclipse on a Refugee Camp*. Representational figures may not be visible but the tension felt by refugees is palpable. The other symbolic importance of the paper capsule is that the horrible news it contained is now concealed in the wrap and all that is now visible is its colour.

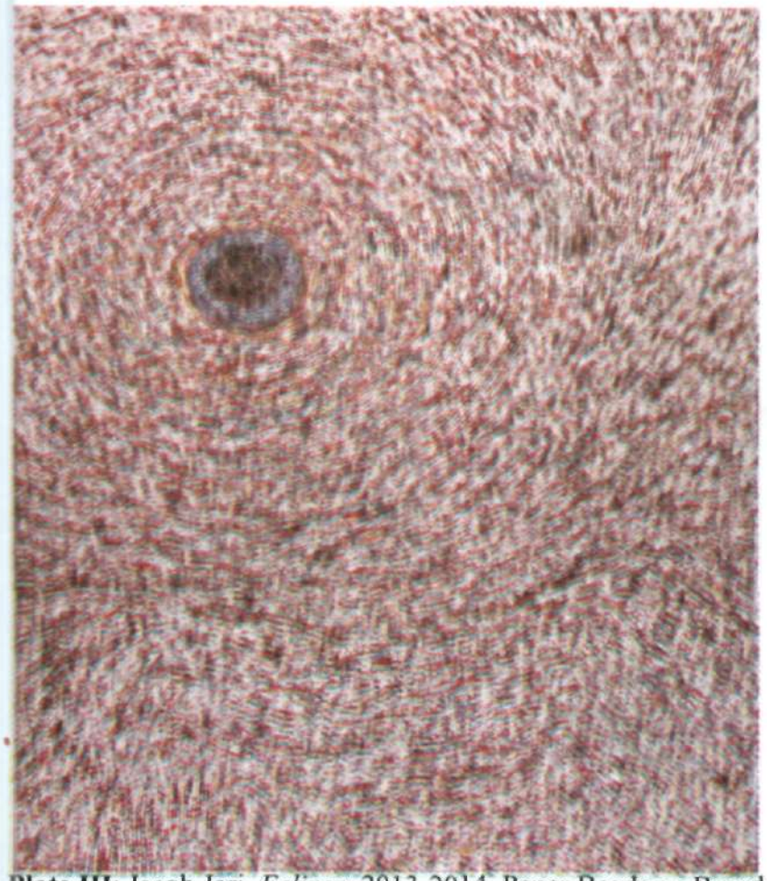


Plate III: Jacob Jari, *Eclipse*, 2013-2014, Paper Beads on Board, 111.8 x 78cm

Another medium I use to express myself is straw. The straw also has to be discarded before use. I pick it up from the streets and slice it like cornstalk into different desired shapes. It is already coloured so I do not need to re-dye it. The pieces however, pose more challenge in sticking to the board than cornstalk because unlike cornstalk, they are hollowed and have slim round edges, which make them difficult to be glued to the support. My choice of straw to represent my feelings about Brighton, a town in England, captured in Plate IV, is informed by my experience in it. While I lived there, it was considered to be the capital of Gay people. There

were several festivities and parties held almost every weekend and so straw was a permanent feature on the streets. The overall colour of the work is impressionistically pink, the colour, I was informed by residents, represents Gay.



Plate IV: Jacob Jari, Detail of *Brighton*, 2007, 2.5' x 3'

My dedication to employ painting to symbolically uplift the discarded into positions of prominence is further illustrated in Plate V. I recall that when I was a child, my uncle bought a new pair of nylon shorts. He returned with it from the market and in excitement

washed it immediately. When it was dry he set out to iron it using charcoal iron but he had made it too hot. As soon as he placed the iron on the pair of shorts, the shorts melted and almost completely disappeared. He was so distraught that for the whole day he would not speak to anyone. While attending the Aftershave International Artists Workshop in Pankshin in 2008, it occurred to me to explore how I could turn that sad experience into something uplifting. I bought charcoal iron and heated it to a high temperature. I used it to create motifs on white fabric, the result of which is seen in Plate V.



Plate V: Jacob Jari, *Untitled*, 2008, Charcoal Iron Impression on Fabric, 110 x 102cm

In my work with rejects, I have also used discarded plastic bottle tops. I obtained a compressed board and drilled holes through it, akin to my boring holes on canvas while working with off-cut

pieces of fabric. The drill bit I used to produce the holes on the board was slightly wider in circumference than that of a bottle top in order to hold the bottle top firmly without the use of any adhesive. The work is illustrated in Plate VI.

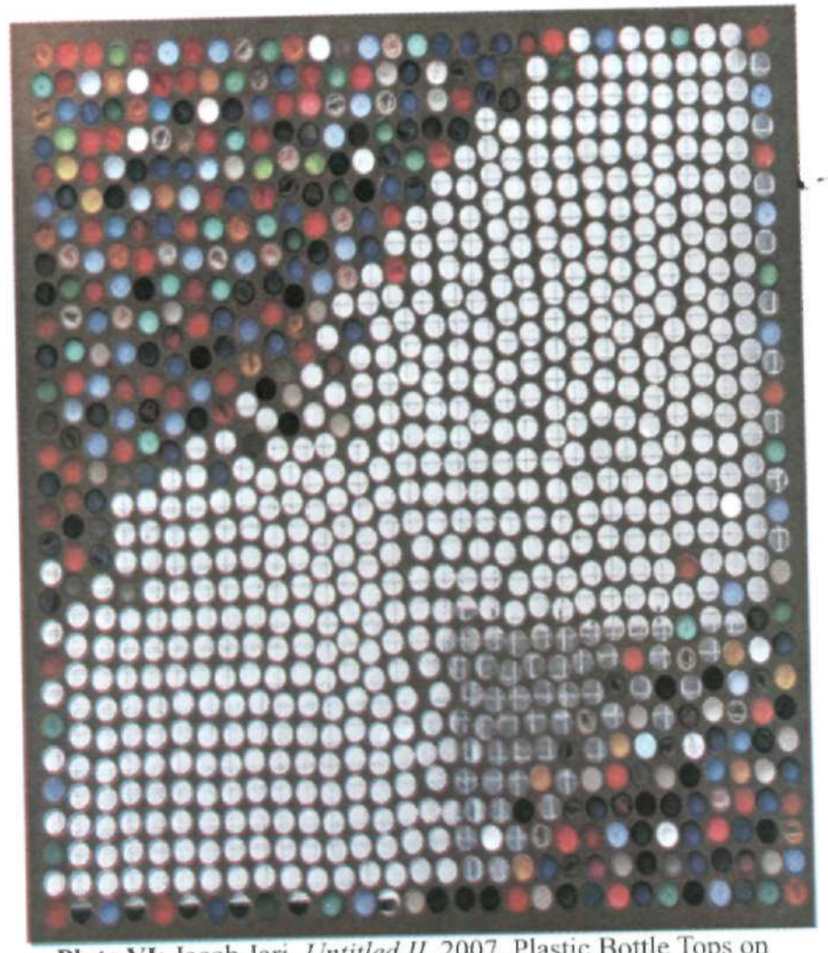


Plate VI: Jacob Jari, *Untitled II*, 2007, Plastic Bottle Tops on Board, 4' x 4'

My entire practice as a Painter for over 25 years has therefore, been consumed by the desire to address the public's uninformed perception of the artist. The groups and events I have been involved with have also been preoccupied with raising the

level of art appreciation in the Nigerian society. In 1992 for instance, along with Gani Odutokun, Jerry Buhari, Matt Ehizele and Tonie Okpe we launched the first contemporary art journal in Africa, *The Eye*. It was meant to provide much needed forum for the discussion of modern art in Africa and to assist academics whose progress in their various institutions was determined sadly by the number of journal papers they had published rather than by the number of exhibitions they had held. We received commendation from important institutions, which included the publishers of *Gallery* magazine in Zimbabwe and the publishers of *Leonardo* journal of art, science and technology in the United States of America. We also received commendation from well-respected artists within Nigeria who included Yusuf Grillo and Dele Jegede. The cost of production was borne by us with no help from funders whom we approached in vain to support us. Eventually, after several editions, we could not sustain the publication.

In 1998, together with Jerry Buhari, Tonie Okpe and Adele Garkida, we founded the *Aftershave International Artists Workshop* as an affiliate of the Triangle Arts Trust in London. The workshop was set up primarily to provide opportunities for middle-career artists in Nigeria to interact with their counterparts from other parts of the world in order to exchange skills and experiences. It is also meant to bring art practice to the doorsteps of the public for better appreciation since the public is usually invited to interact with the artists and the works created. The first workshop held in 1999 in the Museum of Traditional Nigerian Architecture (MOTNA), Jos. 17 participants drawn from eight countries attended. The Plateau State Governor of the time, Joshua Dariye, was so excited about the prospects of the workshop that he donated a piece of land for its establishment. We ran the workshop until terrorism slowed us down.

I introduced a seminar series in 2004 entitled, *Art Mongering* in the Zaria Art School to create the avenue for art students to encounter the different modes of art creation. During *Art Mongering*, which lasts for an hour from 7-8pm every Wednesday except when students are on holiday or at examinations, works created at such workshops as the *Aftershave* or other works of unconventional nature are presented and discussed. Presenters at *Art Mongering* have included a Zaria branch Chairman of the Academic Staff Union of Universities, a Director General of the National

Gallery of Art, Abuja and several other academics from various disciplines. Presently, the Association of Fine Arts Students of the School runs the series.

My literary work is centred on contemporary issues of common concern to Nigerian artists. At this lecture, I have tried to create a montage of most of them, which address the Zaria Art School, and to present them as one unified and seamless story, which gradually exposes the treasures of the school. It has become urgent to uncover these treasures not only because of the misrepresentation of the worth of the artist in Nigerian society but also because of the recently emerging handwriting on the walls of establishment inspired by the catch phrase in vogue, *Internal Generated Revenue*. An exhaustive documentation of all the treasures cannot be accomplished in a lecture such as this. However, illustrative representations of the different kinds of treasures are listed and discussed. These include discussions on a living lecturer as treasure, a dead lecturer as treasure, and a living practice as treasure. The method employed in these discussions is a basic Art Historical method recommended by Feldman (1970) whereby the treasures are described, analyzed, interpreted and evaluated.

Abashiya Magaji Ahuwan As Treasure

Information on Professor Ahuwan or his work is scanty. This is why many publications on artists in this country, one of the most recent of which is Onyema (2010), omit his name. Yet, his ceramics have redefined the boundary between aesthetics and function, and have touched the lives of many around the world.

Ahuwan after obtaining the West African School Certificate from the Government Secondary School, Abuja in 1966, attended the Abingdon School, Berkshire in the United Kingdom and obtained the High School Certificate in 1968. In 1972 he completed a B.A. programme at the West Surrey College of Art and Design, Farnham also in the United Kingdom. He attended the University of Tennessee, Knoxville and the University of North Texas, Denton both in the United States of America obtaining the M.Sc. (in 1976) and the PhD (in 1981) respectively. Ahuwan is not therefore, an alumnus of Ahmadu Bello University in the real sense but he has been teaching here for the past 42 years, a period long enough to make any academic an honorary alumnus.

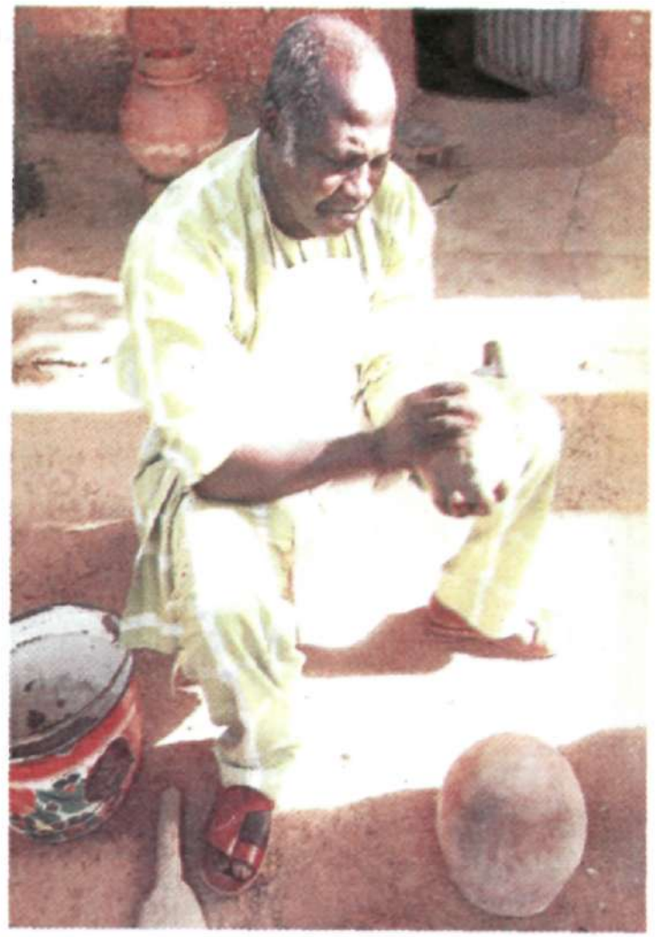


Plate VII: Professor Abashiya Magaji Ahuwan at his studio in Hunkuyi, 2007

Despite Ahuwan's training in modern Ceramics and his exposure to the best conventional materials and equipment, he locates his entire creative endeavour on 100% indigenous content. This is unusual in the Ceramic enterprise which other appellation, *China*, is derived from the overwhelming influence of Chinese pottery on global practice. He does not use the kick wheel nor glazes or modern kilns but produces his pieces through hand building techniques and he fires them in open fire using corn horst, cornstalks, cow dung,

firewood or sawdust. These are typical Nigerian pottery techniques, which he learnt as an apprentice under the great Hunkuyi potter, the late Mallam Mohammed Idi. Hunkuyi is located about ten kilometers away at the outskirts of Zaria. Ahuwan, until Idi's death, maintained his studio at Hunkuyi not only to stay in touch with his master but also because he discovered that the clay around the village was very good for his technique.



Plate VIII: Mallam Idi Mohammed

Ahuwan prepares the clay himself. He begins his work by piling it on an inverted pot and starts to beat gently until the clay takes the round shape of the inverted pot at which point he detaches the new form from the pot and continues to hand-build. His works are therefore, generally round although there may be additional protrusions which maintain unconventional shapes and which give an illusion of a fourth dimension. He also uses animal forms, especially that of the tortoise. The choice of shape is determined by his feeling either at the particular time of creation, as a reflection on a past experience or as a projection into the future. Whatever he creates maintains the qualities of terracotta because he believes that

he is able to find equilibrium between tradition and modernity by remaining down-to-earth natural. This is partly why in finishing his wares he does not glaze them but relies on the different nuances and sheen created through the oxidation, which takes place in open fire. Sometimes he embellishes them with geometric motifs while other times, he leaves them plain. Most of Ahuwan's recent works are purely aesthetic, to be contemplated for their beauty. The older ones are more utilitarian, which brings us to discussing how he profoundly affected the music industry.



Plate IX: Abashiya Magaji Ahuwan, *Flower*, 1989,Terracotta, 9" High

Ahuwan became fascinated by the *kim kim* in the early 1970s. The *kim kim*, also known as *udu*, is a percussion popular with many ethnic groups in Nigeria. With most Southern Kaduna groups from where Ahuwan hails, women play it. It is built like a pot with a long neck and two openings, a wide one at the top and a narrower one on the side. Different tones can be obtained by slapping an open palm on the top opening rhythmically while closing and opening the hole on the side with the other palm. Ahuwan's likeness for the *kim kim* can be seen in the number of variations which he created and magnificently decorated. In 1974, he was invited along with five others by the American government to undertake a three-month teaching tour of the country. One of the institutions he visited was the Haystack Mt. School of Craft, Deer Isle, Maine. It occurred to him to use the traditional techniques he learnt from Idi to teach the

students he met how to produce and play a *kim kim*. One of the students, Frank Giorgini, fully explored the potentials of the *kim kim* as a musical instrument. He presently owns a thriving factory which produces different sizes of the *kim kim* fitted with electronic microphones which are in hot demand by several musical groups around the world. In recognizing the impact of Ahuwan's oeuvre as aesthetic as well as utilitarian, the Metropolitan Museum of Art in New York acquired two of his works as part of its permanent African collection in 1989.



Plate X: Abashiya Magaji Ahuwan, *Kim Kim*, 1990, Terracotta, 12" High



Plate XI: Abashiya Magaji Ahuwan, *Submarine*, 2002, Terracotta, 9" High



Plate XII: *Kim Kim* by Frank Giorgini,
Professor Ahuwan's Student



Plate XIII: Frank Giorgini with sets of *Kim Kim* equipped with electronic microphones

Gani Odutokun As Treasure

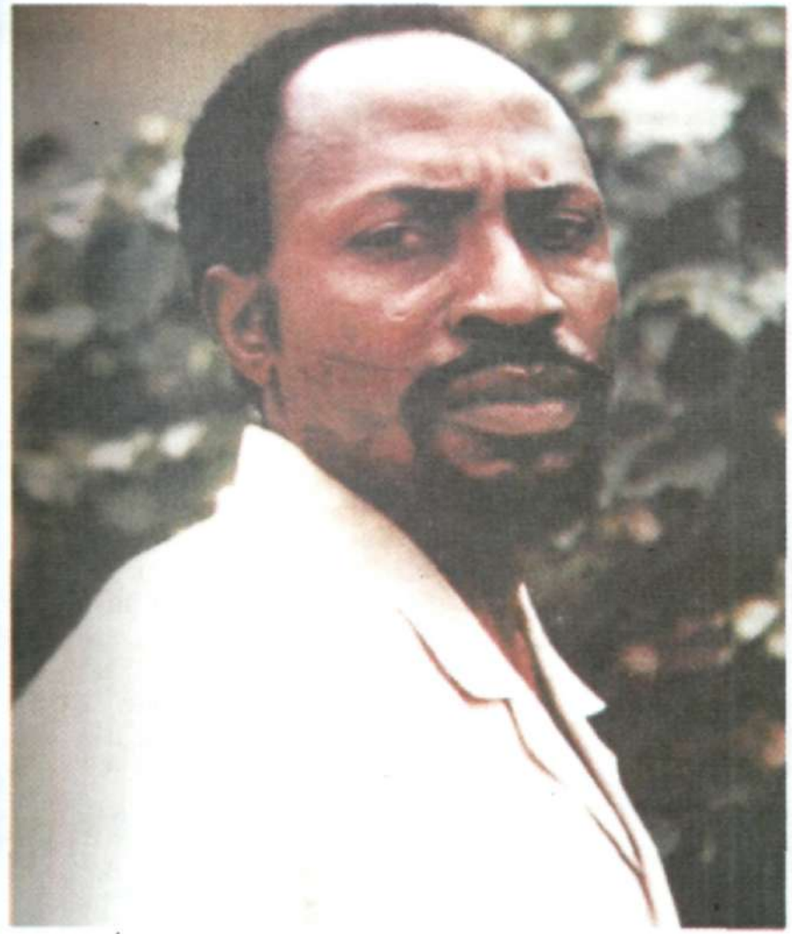


Plate XIV: Gani Odutokun

Gani Odutokun was one of the most influential artists of the Zaria Art School. This was partly evident in the events organized to celebrate his life shortly after his death on 15th February, 1995. The 1995 graduating students of the art school which he headed before he died wrote a moving tribute to him in their exhibition catalogue. At the first anniversary of his death in 1996, an exhibition of his works was organized at the Ahmadu Bello University Museum in

Samaru. In April of the same year the exhibition was moved to the British Council, Kaduna from where it was again moved to the Goethe Institute, Lagos in September. Two months later, in November, the Academic Staff Union of Universities, Zaria Branch, held a seminar in Zaria to mark the anniversary of his death. His alma-matter, the Department of Fine Arts, again held a memorial exhibition in October, 1998. In June, 1999, the first leg of the *Accident and Design* touring exhibition opened at the Alliance Francaise, Kaduna and was moved the same month to the Maison de France, Lagos. The final leg of the exhibition opened to a large and enthusiastic audience in January, 2000 at the Brunei Gallery, London. The organizers were proud of the fact that it was the first exhibition to hold in the gallery this millennium, something of an honour to Gani. It comprised his works and those of some of the younger artists he had influenced. It was one of the rare exhibitions held in London conceived, executed and almost exclusively funded by Africans resident in Africa. The exhibition was well received with favourable reviews appearing in the news at home and abroad. The *West African Magazine* issue number 4212 of February, 2000 for instance, dedicated four pages to its review. In the Spring copy of *Nka*, a journal of contemporary African art published in 2001, there was written a well illustrated article which was favourably disposed to the exhibition. The opening was attended by several highly placed personalities including the Commonwealth Secretary General of the time, Chief Emeka Anyaoku and the Nigerian High Commissioner to the United Kingdom at the time, Prince Bolasodun Adesumbo Ajibola. Sir Robert Loder, the initiator of *Africa'95*, a huge festival of African arts organized in England in 1995, was also at the opening and so were several notable academics, artists and connoisseurs.

The singular event, which however, marks Gani Odutokun as one of the greatest treasures of the Zaria Art School, is the thriving business of forging his works. By 2012, not less than four works were forged and sold. One of the most sensational stories on forgery in Nigeria is that around the forgery of the *Dialogue with Mona Lisa*

It is rare that any artist would like to invest precious time and resources to imitate a work by a less important and hardly-selling artist although it is not entirely impossible. A famous artist may copy a work by a less popular artist and render the work even much

better than the original but he or she would sign his or her name on it. This example is clearer when music is the genre of art under discussion. Some contemporary musicians are in the habit of remixing earlier tunes by other musicians. The difference between this type of copying to the type which *Dialogue with Mona Lisa* represents is that *Dialogue with Mona Lisa* was produced with the sole intention to present it as an original work of Gani in order to exchange for a lot of money, over N3million. This kind of forgery has historical precedents and perpetrators have included even very famous artists. Apart from presenting some of his good students' works as his, which was generally a standard practice and an accepted etiquette, Michelangelo is reported to have faked an antique, made it look ancient and sold it to an art dealer called Baldassare del Milanese.



Plate XV: Gani Odutokun, *The Butterfly that Wanted to Turn Yellow*, 1994, Oil on Canvas, 61x90cm

At the launching in Lagos in 2006 of the book, *Master of Masters-Yusuf Grillo: His Life and Works* published by the National Gallery of Art, this issue of forgery assumed prominence. It became apparent that almost all prominent artists in Nigeria have had their works forged at one point or another for financial gains. These artists include Grillo himself, Bruce Onobrakpeya and Kolade

Oshinowo, alumni of the Zaria Art School who are alive and whose techniques are relatively more difficult to imitate than others. It is easier to copy the work of a dead artist because a living artist may have the opportunity for refutation. Gani's works comparatively were therefore, more tempting to forge. By the time he died on 15th February 1995, his works were among the most sought after in the country. His technique of pouring liquid pigment on his support and his philosophy of accident and design, exemplified in Plate XV, were particularly well received by collectors and art connoisseurs. Moreover, he was fast becoming the epitome of the academic artist, having become the head of the premier art department in the country, the Department of Fine Arts, Ahmadu Bello University, Zaria and the national vice president of the Society of Nigerian Artists.

The *Dialogue with Mona Lisa*, probably the most iconic painting Gani ever created, was painted in 1991. In 1992, he took it along on his first and only trip to England. He was attending an exposition of his works by Leroy Coubargy who owned and managed the Savannah Art Gallery in London. Several postcards, which Gani brought home on his return, were made of the painting. He however, left the original work behind with Coubargy. The subsequent disappearance of this painting has become a mystery. While working towards the Accident and Design exhibition, which held in London in 2000, the curators wanted to include it as one of the exhibits. Coubargy at this time had already shut down the gallery and was reported to have left England for Ghana, leaving behind neither contact address nor number. John Picton, a Professor emeritus of the School of Oriental and African Studies, University of London, confirmed that Coubargy left suddenly. Picton reported that he was informed of the intention (of the owners of the property where Savannah Gallery used to occupy) to auction what Coubargy left behind in the property. These included some personal effects and works, which by now were removed and kept outside at the mercy of the treacherous London weather. He feared that being a gouache, the *Dialogue with Mona Lisa*, if it was part of what was left in the rains, would have been destroyed because he attended the auction but it was not presented as one of the items for auction. It appears a few people have been interested in the painting. On 20th July 2010, Frederick Lamp, author of *Art of the Baga*, posted a

notice seeking information on its whereabouts on the net. Until May 2012, nobody had openly claimed to sight the painting anywhere since Gani left it with Coubargy in 1992.



Plate XVI: Two Images of the *Dialogue with Mona Lisa*, one of which is Forged

On page 45 of the 2012 Arthouse auction catalogue, the image of the *Dialogue with Mona Lisa* made a sudden appearance! Information about the painting on the same page revealed that the present owner acquired it from Gani's estate and would wish to sell it for N2.5million- N3million. Upon close scrutiny and comparison of the image in the catalogue to that on the postcards Gani brought home from England in 1992, however, it became obvious that the one in the catalogue was that of an imitation. The representative of

Gani's estate, his wife Elizabeth, denied any knowledge of the whereabouts of the painting after Gani took it to England in 1992. She was then prompted to visit the Arthouse in Lagos to clarify the authenticity of the painting and to ascertain who brought it for auctioning. She confirmed that the president of the Art Galleries Association of Nigeria brought it to the Arthouse. When she met him, he explained that he purchased the work from a certain artist for N120,000. This artist, who did not represent Gani's estate, could neither be located nor contacted. After purchasing the work, the president of the Art Galleries Association met the dean of the School of Art, Design and Printing, Yaba College of Technology Lagos, to authenticate it as an original work of Gani Odutokun. The dean obliged. He was to declare later that the painting he was supposed to authenticate was not presented to him. He however, set to work using the image of the same painting in a book entitled, *Understanding Art* by Lois Rathur. On an official letter-headed paper signed, stamped and dated 30th April 2012, under the subtitle, *Synoptic Aesthetic Scanning*, he authenticated that,

> The primary visual simulation of the above-named artwork by Professor Gani Odutokun, confirms that the artwork is an original product of the said artist. The tactile effects, both frontal and back reveal and correspond to the signed date of production. The colour scheme and modulation also reveal that of Prof Gani Odutokun. The Pictorial composition is original and it is of the said date signed on the work. Signature of the artist is that of Prof Gani Odutokun.

The questions that should then be asked include: how did the dean conduct an aesthetic scanning to arrive at such definite conclusions without the work? What are the implications of using an official position to authenticate a work that was not visible? The date of the letter should also be noted. By this date, the Arthouse had already tried severally to contact Gani's wife over the painting, which suggests that the letter the dean wrote was prompted by an anticipated challenge of authenticity. Very few people knew that the image of the original *Dialogue with Mona Lisa* was on postcards available to people who would pose this challenge. The president of

the Art Galleries Association, when confronted with the postcard image and after comparing it to the painting he brought for auction, eventually conceded that the latter was an imitation.

Retaining Works Of Graduating Students As Treasure

So far at this lecture, we have discussed a living artist, Abashiya Ahuwan as treasure and we have also discussed a dead artist, Gani Odutokun as treasure. We now discuss another treasure, a living practice, which is the reservation of the works of graduating students, a practice as old as the Zaria Art School. In the good old days in the art school, all art materials were supplied free. The reason for the cessation of supply in the late 1980s is yet to be established but many departments other than Fine Arts continue to enjoy supply of materials to their laboratories. When the materials were supplied free, the art students were encouraged to produce as many art works as their creative impulses led them. The department did not feel any restrain to retain any work it chose. In the 1960s, 70s and part of the 80s there was a strong collection of art works which had been built from retaining works of dynamic artists like, Clary Nelson Cole, Elis Erimona, Roland Abiodun, Christopher Adepegba, Kolade Osinowo, Edward Ejembi, Dele Jegede, Gani Odutokun, Richard Baye, to mention a few. Most of these works were kept within the department while a few were kept in other spaces within the University such as the Kashim Ibrahim Library, the sick bay, the Veterinary Hospital, and the gymnasium. Retained sculptures in the department were kept either in the sculpture garden or in the sculpture store while the paintings were kept in the painting store in the roof of the building. The practice of retaining works, despite the fact that students now buy all their materials, continues to this day.

It is obvious why some works of graduating students should be retained. Apart from their aesthetic appeal, they are retained most fundamentally because they are used as teaching aids to illustrate the various methods and techniques of art creation. Other students are also able to appreciate the standard already attained in the school. They should therefore aspire to equal or surpass it. Retained works are also useful during exhibitions. Since they are representative works of every student, a collection of them gives a panoramic insight into the school's expression. They have been known to

feature prominently in important exhibitions such as the one earlier referred to as organized by the National Council for Arts and Culture in 1990 entitled *Zaria Art School* under the Evolution in Nigerian Art Series. Occasionally the department or the University finds the need to give someone a befitting present. Retained works are sometimes presented. Retained works especially sculptures have given character to the overall ambiance of the department. Perhaps the Sculpture Garden is the only one of its type. It has attracted all kinds of people from far and near for all kinds of reasons. It is one of the sites for instance where friends of girls from neighbouring villages who are about to marry take her for sightseeing.

Conditions of Retained Works

Many believe that works of art are as secure as the architectural structure in which they are housed. It should be noted of course that the security of a structure includes the nature of those to whom the structure is accessible! In the Sculpture Garden for instance, where anybody could do anything to the sculptures, including helping the artist to change a few anatomical details, priceless works have seen all kinds of abuses. There are of course also those that the weather is helping to reform. However, the sculptures, which have been kept in the store, the ones which have escaped the interest of those to whom the store is accessible, still maintain their forms.

Paintings on the other hand have not been this lucky. A very strong collection of them was gathered over a period of about thirty years and kept in a tiny space in the roof of the departmental building. This space became too small to contain more but before any alternative space would be found, the building itself began a process of disintegration starting from the roof. It began leaking rain profusely unto the paintings so they had to be moved down to one of the sculpture studios. All this happened around the mid 1980s. It was also about the same time that funds to run universities dwindled and so students were not supplied materials free anymore. Catastrophe stroke! One by one students went into the sculpture studio where these paintings were kept and stole them out not to sell but to re-prim and paint on their support! Imagine a fresh student re-priming Dele Jegede's painting in order to use its support!

The final blow that saw to the complete removal of the paintings was the sudden market for them. Finance houses suddenly sprung up overnight and made instant millionaires out of some middle class Nigerians. These Nigerians in order to look real were imitating their peers elsewhere in Europe, reading about their exploits in auction houses like Christies and Sotheby. Art works, particularly of well-established artists, became very marketable. This time it was not only students who stole the reserved paintings. Other people who had access to where they were kept also stole some. They were then sold to collectors. The collection of paintings now in the department comprises mostly recent works. Any old work would have been brought back from where it used to hang outside the department. A random selection of reserved works strewn around the University is assessed and their conditions are revealed below.

***Charging Bull* by Gani Odotokun**

The exhibition, *Accident and Design: Gani Odutokun and His Influence* was to open in another week in London and there was the need to bring along as many people as possible to the opening. One of the people the curators spoke to, acknowledged that Gani's name was familiar because his mother owned one of his paintings! He went ahead to describe the painting. He was shown an illustration in the catalogue and the curators were surprised that it turned out to be the image of the work his mother now owned. Naturally, they asked him how she acquired it. He said a certain artist, who trained in Ahmadu Bello University, Zaria gave her as a present. The second surprise was that the curators knew this artist.

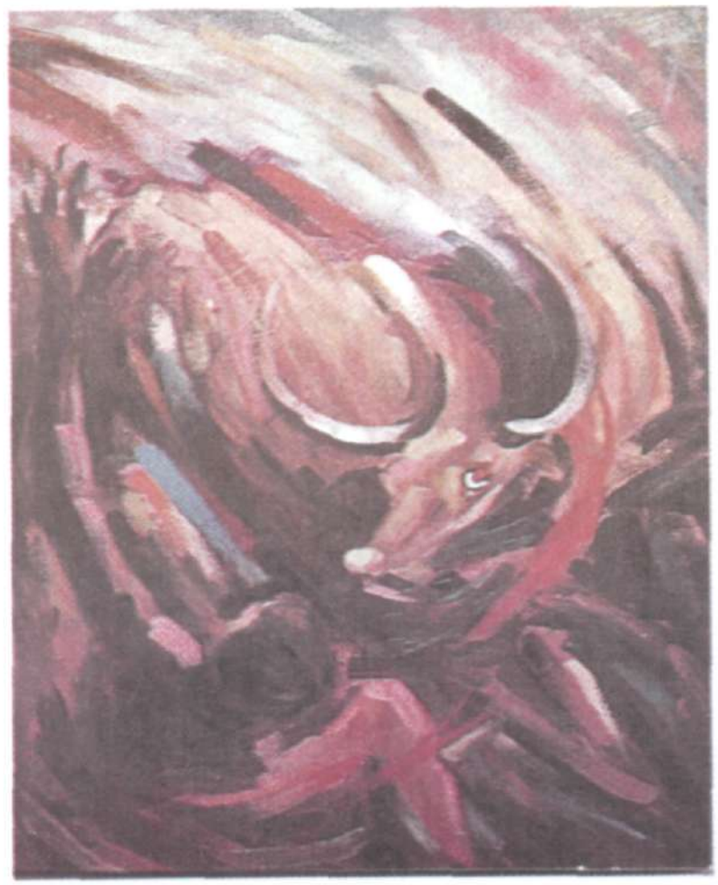


Plate XVII: Gani Odutokun, *Charging Bull*, 1975, Oil on Board

The painting in question is called *Charging Bull*. Nobody in the department could remember the last time it was seen but many remembered that it carried an *R* written in chalk on the top right corner. The image of the painting reproduced in Plate XVII bears testimony to this *R*. It represents the word, *Retained* or *Reserved*. So, how did Gani's retained work end up as a present from one of his students?



Plate XVIII: Joe Musa, *Alice,* 1987, Pastel, 26"x30"

***Alice* by Joe Musa**

Alice, shown in Plate XVIII, is a pastel drawing created by Joe Musa, the erstwhile Director General of the National Gallery of Art, when he was a student in the Zaria Art School. Alice, the model who posed for the drawing, rose to the position of head model before her retirement but she rarely smiled while posing giving the

impression as if she did not like her job. Joe Musa's drawing, a realistic work, shows Alice wearing one of those her moody looks. The work hung in one of the offices in the Department of Fine Arts since it was retained in 1987, the year Joe Musa graduated with a First Class. It was taken on loan for the *Zaria at 50* exhibition held in Abuja in 2007. Since then, it has not been returned.

***Market Place* by Clary Nelson Cole**



Plate XIX: Clary Nelson Cole, *Market Place*, 1969, Oil on Board, 76cm x 92cm

The records show that Clary Nelson Cole graduated from the Zaria Art School in 1967 although his painting, *Market Place* shown in Plate XIX indicates that it was painted in 1969. It is likely that he might have had dealings with the School after graduation and before he left for the University of Illinois, U.S.A. for further studies. This was not unusual, as a few works by teachers who were not alumni of the Zaria Art School could and did find their way into the School's collection. Cole stayed in the U.S.A. for a few years teaching in the same university and winning many awards for his work. He was featured by the Miller Brewing Company and became one of very few African artists to be exhibited by the Museum of Modern Art,

New York. He returned to Nigeria and taught at the University of Benin rising to become a Professor. It is a mark of his relevance that although he died in 1990, a year when the Internet was relatively new in Nigeria, many websites continue to display his works. *Market Place* is one of the oldest surviving paintings in the Zaria Art School Collection. It was one of the paintings salvaged from the store in the roof of the School's building when it leaked. It now hangs in one of the offices but it has begun to flake and the nails, which hold the support to the back frame, are creating wide holes on the support. The figures in the painting show a busy market scenery akin to any market scene in Zaria. The uniqueness of the work is however, resident in the stylized forms reminiscent of Honore Daumier's, which were linked to the oppressed in society. Such rendition of figures was peculiar to Nelson Cole in the Zaria Art School.

***God Save Me and my Small Child* by H.I.C.A. Yebusika**

The highest number of the Zaria Art School's paintings of the 1970s is found in the Kashim Ibrahim Library. One of the most imposing paintings in the Library is Yebusika's 1977 painting entitled, *God Save me and my Small Child* shown in Plate XX. It is imposing both in terms of its size as well as subject matter. It measures almost six by four feet and shows a mythical eagle attempting to pick up a child who has docked under his parent. The claws of the eagle are sunk into the parent's back indicating that the eagle at this point is prepared to snatch up the parent. This painting has been hanging on the same spot on the first floor for 37 years. It is easily accessible to library users moving to the right wing of the library. It has therefore suffered abuses. There are now horrible scribbles and writings on the surface of the painting such as, *No Vernacular*, *Kolo*, and *DTF* as illustrated in Plates XXI, XXII and XXIII.



Plate XX: H.I.C.A. Yebusika, *God Save me and my Small Child*, 1977, 66"x42", Oil on Board



Plate XXI: Detail of *God Save me and my Small Child*



Plate XXII: Detail of *God Save me and my Small Child*



Plate XXIII: Detail of *God Save me and my Small Child*

***Nigerian Townscape* by Gani Odutokun**



Plate XXIV: Gani Odutokun, *Nigerian Townscape*, 1975, Oil on Board, 37"x48"

One of the retained works of Gani Odutokun, *Nigerian Townscape* shown in Plate XXIV, can be viewed at the top floor of the Kashim Ibrahim Library. It shows an earlier technique employed by Gani. He uses wide and expressive brush strokes to portray typical features of a township street. Rooftops, cars and story

buildings are suggested. The painting looks smudgy from more than 39 years of settled layers of dust.

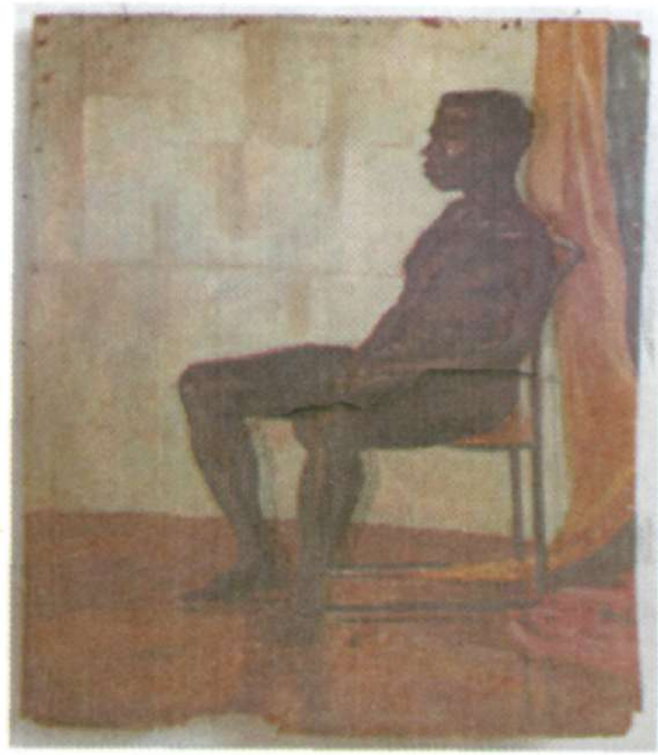


Plate XXV: Kolade Oshinowo, *Johnson*, 1972, Oil on Board, 101cm x 75cm

***Johnson* by Kolade Oshinowo**

Johnson is a life study of a model of the same name by Kolade Oshinowo, a Zaria Art School graduate of 1972. Oshinowo is one of the most illustrious alumni of the School and one of the most sought after by collectors. He became a colossus at the Yaba College of Technology having taught there for almost four decades and becoming a Deputy Rector for two years. Oshinowo is also an erstwhile President of the Society of Nigerian Artists. The painting, which shows a seated figure (see Plate XXV), is one of the very few surviving life studies from the 1970s. It is unfortunately, in a terrible state as it is cracked at the edges as well as the centre.



Plate XXVI: Detail of *Johnson*

***The Gate* by Barbara House**



Plate XXVII: Barbara House, *The Gate*, 1978, Acrylic on Board, 76cm x 122cm

The Gate, (shown in Plate XXVII), was painted in 1978 by one of the last British teachers to leave the Zaria Art School.

Barbara House's interest in painting ordinary people living ordinary lives was well established. *The* Gate, most likely studied from life, shows traffic at the Zaria City Gate. The objects and figures are captured in their most characteristic postures. This painting confirms Barbara's great understanding of the anatomy of the different species represented. With an economy of lines and a simplistic representation, she captures the essence of the species. The work hangs in one of the offices in the department. It has begun to flake in a few places.



Plate XXVIII: Wale Ajayi, *Green Revolution*, 1990, Oil on Canvas, 76cm x 122cm

***Green Revolution* by Wale Ajayi**

Plate XXVIII shows a painting, *Green Revolution*, created by Wale Ajayi in 1990. It portrays eight portraits of heads of State beginning from Alhaji Tafawa Balewa and ending with General Ibrahim Babangida. Of the eight heads of State, only two are civilians; the others are military generals wearing their uniforms, hence the title, *Green Revolution*. The work is a reflection of the influence of the military on Nigeria's politics. It is displayed in the office of the head of the Department of Fine Arts.

***The Bar* by Roland Abiodun**

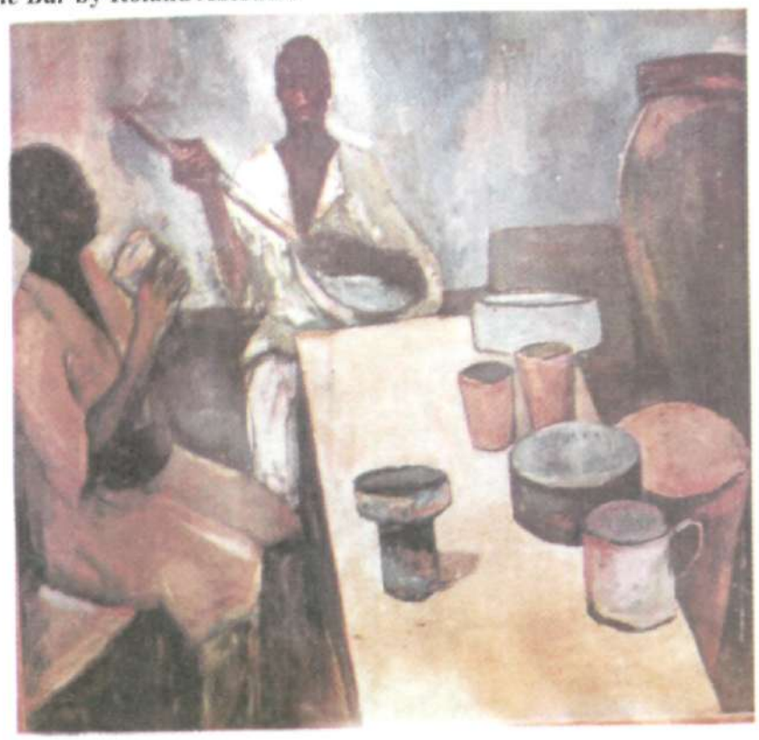


Plate XXIX: Roland Abiodun, *The Bar*, 1965, Oil on Board, 4'x5'

The work by Roland Abiodun, the first graduate to earn a First Class in the Art School, is shown in Plate XXIX. Roland graduated in 1965. This painting has always been kept in the Painting Section of the department but it recently disappeared. Information on it is contained in early exhibition catalogues of the School.

***21st Century Farmer* by Vitalis Abaver Ajir**



Plate XXX: Vitalis Abaver Ajir, *21st Century Farmer*, 2013, Fibre Glass, 107cm High

Vitalis Abaver Ajir, a graduate of 2014, produced the Sculpture shown in Plate XXX in 2013. He graduated this year,

2014. The work renders, in very good anatomical proportions, a farmer carrying a sack and fiddling with his mobile phone. It illustrates that the present graduates of the Zaria Art School continue to produce highly skillful works worthy of reservation.

It should be noted that the works, which have been discussed so far, are not by any means the only works in the Zaria Art School collection. There are hundreds if not thousands of works stashed in different places in the University. They have been selected for discussion only for the purpose of illustrating the variety in available documentation on them as well as their state of preservation. Information on some works and artists are more available than others and some works are more preserved than others. The consequences of the absence of detailed documentation of the works and the poor state of preservation will be discussed shortly. The works shown in Plate XXXI, XXXII, XXXIII and XXXIV are a few of many works that fall under the category of poor documentation. The little, which is known about them, was passed by oral tradition from one generation of students to another. The artists signed none of the works although older staff of the department may correctly identify them. Ellis Erimona, a First Class graduate of 1976, for instance, purportedly created the work shown in Plate XXXI. It was displayed for several years in the Sculpture Garden before it was moved to the space beside the Theatre AB of the Faculty of Environmental Design. It lost many of its parts and was restored but it has begun to lose them again partly because of abuses from passers-by. The charcoal portrait of an Arab shown in Plate XXXII is attributed to Tyrone Geter, an African-American teacher who left the Zaria Art School in the late 1980s. The title and year of production of the work is not known. One of the best sculpture portraits ever produced in the School is shown in Plate XXXIII. It is a representational study of a model known as Hauwa. It has been attributed to Jide Emordi, a graduate of 1989. The composition of a drummer and a dancer is shown in Plate XXXIV. The artist, Obi Chinedu, wrote his name and the year of production at the base of the work. It was produced in 1990, the same year in which the artist graduated. The title of the work, however, is unknown. It has attracted interest from several units of the University including the Department of Theatre and Performing Arts, which adapted a motif

from its image as the department's logo. The sculpture is conspicuously displayed in front of the departmental building of the Zaria Art School.



Plate XXXI: Ellis Erimona, Title Unknown, 1976, Cement, 8'High



Plate XXXII: Tyrone Geter, Title Unknown, Year of Production Unknown, Charcoal, 64cm x 44cm



Plate XXXIII: Jide Emordi, *Hauwa*, 1989, Cement, 40cm High



Plate XXXIV: Obi Chinedu, Title Unknown, 1990, Cement, Life Size

How Retained Works And Their Artists Became Treasures

The intrinsic value of a work does not necessarily turn the work into a treasure neither does a First Class art graduate necessarily become a hot-selling artist. A work may score very high in the employment of the appropriate elements and principles of design but remain unsold or undesirable. It may be in a highly recommended medium or size and still not impress a collector. Both work and artist require propaganda and connoisseurship to attract some value. A simple classroom experiment was conducted by me some years ago to prove this phenomenon. I brought out four of my old drawings and showed students. Since they were not signed, the students did not know the artist. I tagged them, A, B, C, and D. I told the students that A was produced by me; Gani Odutokun produced B; Bruce Onobrakpeya produced C while Jimoh Akolo produced D. The students believed me since they were conversant with the tradition of retaining works of graduating students in the Zaria Art School, where this experiment was conducted. I then asked them how much they were willing to pay for each drawing. It was interesting to note that while drawings B, C, and D attracted substantial amounts, nothing significant was offered for A. Yet, in reality, I created all the drawings. I asked the students what informed their decision to award such prices and they simply explained that the other artists were more established than I. It goes to prove that the price of a work is hardly determined by the quality of the work but by the reputation of the artist.

To further illustrate this point, the performance of the works of two classmates, Jimo Akolo and Demas Nwoko, 1961 graduates of the Zaria Art School at a recent auction is compared. Both of them had helped to found the Zaria Art Society in the 1950s. Akolo's fallout with the society shortly after its founding is a matter for another lecture but suffice it to state that both artists grew in stature, each producing and exhibiting at home and abroad. Since Akolo lived and worked much of his life in Zaria, I was more conversant with his work ethics. He constantly painted at home although for many years he was a member of the Ahmadu Bello University administration as well as a Professor. A great draughtsman, Akolo won many prizes both in drawing and painting. Indeed, it was rumoured that he was probably the best painter of his graduating class which included Demas Nwoko, Uche Okeke and Bruce Onobrakpeya. In 2012 Akolo's painting, *Untitled*, was auctioned by Arthouse in Lagos for N700,000. Compare that to the amount, N7,000,000, at which Nwoko's work, *Praise Singer*, was auctioned the same year by the same Arthouse. By the way, both artists are alive. So, what parameters were used?



Plate XXXV: Demas Nwoko, *Praise Singer*, 1961, Oil on Board, 36" x 48"

Something about the history of the artist contributes to the reception of his or her work. In 1995, in a paper entitled, *The Signature on a Work of Art*, I argued that in order to have an objective assessment of a piece of work, its creator should be hidden from the audience because failure to identify the artist, the audience is forced to appreciate the work based on the aesthetic criteria available to it. When the artist is initially identified however, the tendency is to excuse any flaws if the artist was reputable and to see many of them if the artist was not that reputable. I presented this paper at a conference attended by many artists including Chika Okeke-Agulu who, I remember, argued that it was necessary for the audience to identify the artist in order to make the appreciation of the artist's work complete. According to him, when an artist displays his work, the artist was also on display. By this logic therefore, the price of a work is influenced by the reputation of the artist. To further illustrate this point, I had cited in the same paper, earlier mentioned, the case of an artist in the Philippines described by Domingo Alconaba, once an art teacher at the Zaria Art School. Alconaba stated that this artist was so immensely popular that there was a very long queue for his works to the extent that collectors

could not wait for him to create paintings. They were content to buy primed and signed supports by him.

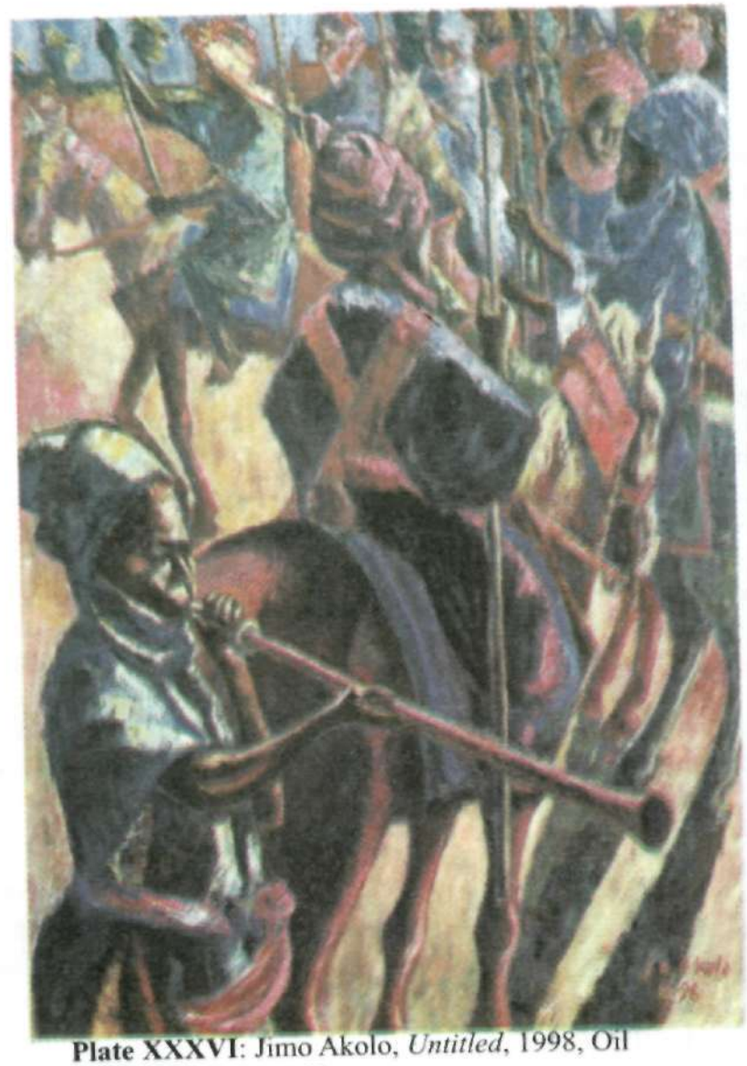


Plate XXXVI: Jimo Akolo, *Untitled*, 1998, Oil on Canvas, 48" x 36"

The more the artist's reputation soars, the more value his or her works attract. For instance, in a comprehensive list of Gani Odutokun's works drawn by Arts and Objects, his agent in 1995, the

most expensive gouache cost N35,000. In today's art market, the same work would cost higher than N3,000,000 as demonstrated in the attempted sale of the forged *Dialogue with Mona Lisa*. An oil painting by the same artist, the *Nigerian Townscape* in the Kashim Ibrahim Library, for instance, would certainly cost far higher than N3,000,000. Several factors are responsible for the soaring of an artist's reputation. If we went back to our comparison of Akolo and Nwoko, we would find that Nwoko became more popular than Akolo as a result of his continuous membership of the Zaria Art Society. A lot of truths and myths have been written about this society to the extent that it has become indispensable in the discourse on modern Nigerian or indeed African art. Nwoko had also edited and published a popular art magazine for many years, the *New Culture* magazine in which his works and those of some of his contemporaries were published. Nwoko also became a successful architect for his use of vernacular architecture and was commissioned by several institutions, organizations, and private clients. He continued to be active for many years in the Society of Nigerian Artists. He therefore, remained constantly in the art news unlike Akolo who although was very active and successful as a Professor in Ahmadu Bello University, was not that visible.

Apart from creating unique and innovative works, visibility is an important ingredient towards adding value to both producer and product. Propaganda from the artist and his agents or patrons is constantly required. This is illustrated in our story on Professor Ahuwan. Until his trip to the United States of America in 1974 and the subsequent propaganda of his work there by a student he met, Frank Giorgini, he remained relatively unknown in his country, Nigeria. It was not the National Gallery of Art, Abuja which acquired his works but the Museum of Modern Art, New York. Despite the fact that Professor Ahuwan for a long time had not been prolific in production because of his engagement with University administration in different capacities, when he eventually exhibited his wares in Kaduna in 1996, a town relatively virgin in terms of art sales, all his exhibits sold out! If only the Zaria Art School had a few of his works in its collection! If only one of his Nigerian students were as innovative as Frank Giorgini, there would have been at least one flourishing factory creating employment and wealth in the country.

The art market in Nigeria has continued to flourish. Apart from the traditional private galleries, which sell artists' works, there have been introduced auction houses, which have been recording tremendous successes in sales. One of such auction houses is the Arthouse. It has sold works by many established and up coming artists a substantial percentage of which graduated from the Zaria Art School. The works by artists like Bruce Onobrakpeya, Kolade Oshinowo, and Yusuf Grillo have maintained record figures at these auctions and they will continue to appreciate because of the propaganda the auction house makes on them. The School's collection continues to benefit from such propaganda since it comprises works of the same artists managed by the auction house. If for instance, the auction house sold a work by Onobrakpeya for N5,000,000, any work by him in the School's collection would fetch similar amount. Indeed, early works by artists are even known to sell for higher prices than recent ones.



Plate XXXVII: The Old SBS Library, One of the First Buildings to be Allocated as Gallery

Conclusion

Given that we now know how valuable the works we have retained from students have become, there should be some effort to spotlessly preserve them. There is no better place to provide for

them than a befitting gallery. This is not a new Eureka. Many heads of the Zaria Art School have tried in the past to establish this gallery. The real chance came during General Mamman Kontagora's tenure as Sole Administrator in 1998, when Professor Jerry Buhari was head of the School. The building, which presently houses CISCO, shown in Plate XXXVII was suggested but before the Art School could take it over, it was reallocated. It took several more years before Professor Shehu Abdullahi as Vice Chancellor in 2006, directed the late Professor Yakubu Nasidi then his deputy, to assist in identifying another building as gallery. Many buildings were recommended including the present School of Postgraduate Studies but the one, which appeared more vulnerable, was the former Community Bank building shown in Plate XXXVIII.



Plate XXXVIII: Former Community Bank Building

The decision however, to turn the building into a meat shop finally won although to this day, it is uncertain what is sold in it. The Art School had become desperate at that time and was willing to take any structure as a starting point for the gallery. In its desperation, it continued to hackle the administration until the Vice Chancellor, agreed to allocate the entire complex, which used to be the mechanical workshop near the Estate Department to the Art

School. The main structure shown in Plate XXXIX was identified as the gallery. This too in 2013, was reallocated.



Plate XXXIX: Most Recent Structure Identified as Gallery

Many exemplary university galleries exist elsewhere such as the Brunei Gallery at the School of Oriental and African Studies, University of London and the gallery at the Makerere University, Kampala. Apart from preserving works, they provide much needed cataloguing. They complement art teaching by providing facilities and opportunities to improve curatorial skills. They host exhibitions of works from other parts of the world thereby providing opportunities to view different techniques in art making. They also hold workshops, residencies, lectures and symposia where established artists from different parts of the world are brought to demonstrate their skills to up-coming artists. Apart from their role as teaching, learning and research facilities, they propagandize the works and artists in their collection.

In this lecture, I presented the origins of the name, Zaria Art School, ascribing the earliest such reference to the Department of Fine Arts of our University to Beier (1960). I referred to the seeming disregard for art in our University as a hangover from tradition

illustrating this with the circumstance around the death of *Baban Gwani* Muhammadu Mukhaila Dugura and the unfortunate celebration of Okonkwo as hero rather than his father, Unoka, in Achebe's *Things Fall Apart*. I testified that the indifference to art has shaped my practice of conceptually projecting discarded objects to aesthetic prominence. I illustrated how Ahuwan, Gani and the reservation of art works became treasures, which our University is yet to recognize. I observed however, that the retained works are in constant danger of abuse and suggested that a university gallery be established for them.

Throughout the lecture, I have felt uneasy emphasizing the monetary worth of works over other intrinsic values. Hughes (1991), in addressing the issue of art and money, first looks at two extreme cases as presented by William Blake and Samuel Johnson. "Where any view of money exists", wrote Blake, "art cannot be carried out." On the other extreme, Johnson was just as categorical. "No man but a blockhead", he said, "ever wrote, except for money." Hughes, who appears to argue on the side of Johnson, cites the example of how artists like Tiziano Vecelli, Gian Lorenzo Bernini and Nicholas Poussin became good artists through patronage and how Pablo Picasso "was a millionaire at forty and that didn't harm him." The circumstances of the lecture have made siding with Johnson inevitable. Nevertheless, I would proffer that in the course of time some artists become cultural icons. Their works become priceless cultural artifacts. Their abodes therefore, become highly attractive cultural destinations. For instance, France has gained other benefits from visitors coming to the Louvre to view the *Mona Lisa* than what it would generate if it were sold. If ever there were a qualified location for a *Louvre* in Nigeria, it would certainly be the Ahmadu Bello University, Zaria.

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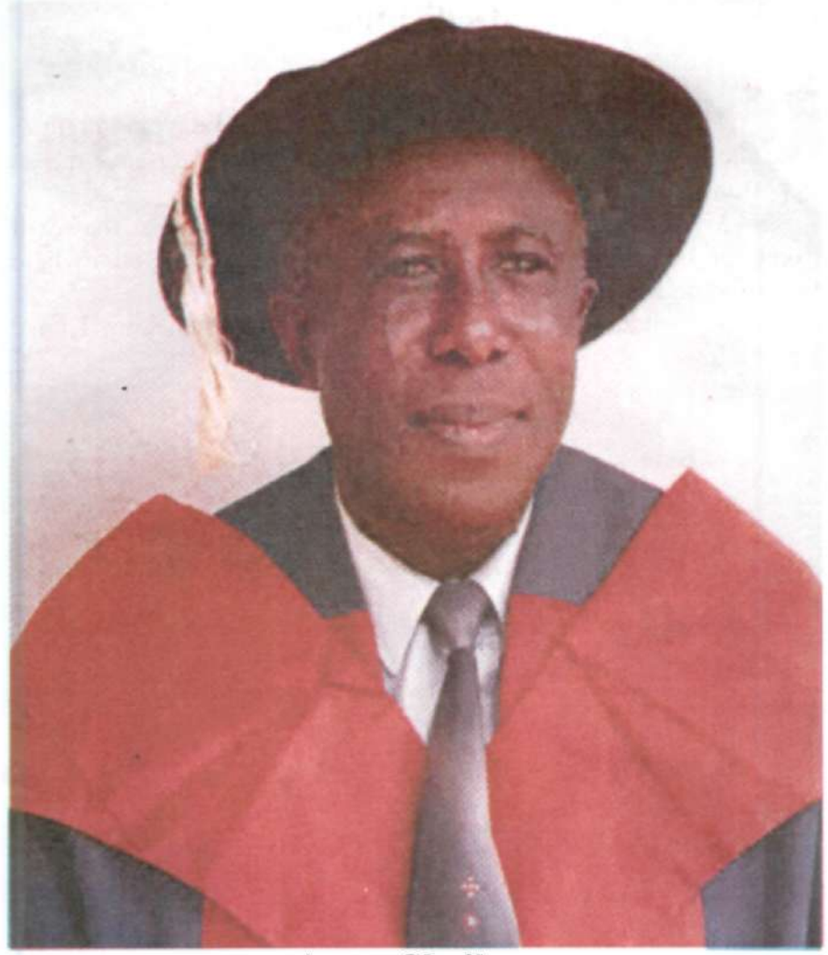
Chapter Eight

Navigating the Maze of Students' Underachievement in Science: Does Science Education Research Provide a Road Map?

Navigating the Maze of Students' Underachievement in Science: Does Science Education Research Provide a Road Map?

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Wedne day, 2na July, 2014



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Dedication

To:

The memory of my late parents who toiled day and night to send me to school and stood by me all the way. They gave me an opportunity they themselves never had.

My children and grand children in the hope that they will excel far beyond whatever achievements it pleased God to here bestowed on me.

My students who taught me a lot and from whom I have learnt a lot.

Acknowledgement

To God be the glory great things He had done. My profound gratitude and appreciation go, first and foremost, to the Almighty God maker of all things, both seen and unseen. He has been the one who has provided me solace, support and sustenance. He has stood with me and by me in thick and thin, rain and sunshine and at every turn and bend. To Him be honour, glory and adoration forever and ever more.

My thanks go to my late parents who dedicated themselves and all they had to send me to school and saw me through my school days. Though they have gone the way of all flesh, but their sweet memory remains indelible in my mind and consciousness. I pray for them, as always that their soul will continue to rest in perfect peace.

I want to thank the successive Vice Chancellors especially the incumbent, Prof. Mustapha Abdullahi and University management since 1976 that I joined Ahmadu Bello University as staff for opportunities I have had to study, teach and research. I wish also, in the same vein to thank the university organized lecture committee for giving me this unique opportunity, to give account of my academic and professional endeavours and stewardship.

I do thank, most sincerely the Dean of my Faculty, Professor Tijjani Abubakar for the immense logistic support he gave me in the course of preparing for this lecture. I found him extremely friendly and understanding. I also thank my Head of Department Dr. Mamman Musa for his encouragement and understanding. I also extend my thanks to my colleagues and friends in Faculty of Education, and especially in the Department of Science Education, most of whom had been my former postgraduate students. We have lived and worked together as brothers and sisters. That experience had been most encouraging and rewarding.

At an occasion like this, I remember with nostalgia and profound gratitude to my teachers at all levels of my educational pursuit – primary to university. May God bless them all, and may the soul of those amongst them that have passed on rest in perfect peace (Amen).

I remember with profound appreciation, individuals who have played key roles along my life's journey. Though too many to mention exhaustively a few of them are: Mr. D. J. K Farrar, my principal in secondary school, Okene who offered and paid my school fees just before and after I lost my father in 1971. Mr and Mrs Alvan Whitehead who cared for me and my family while I was studying as a PhD student in England. Prof. Adamu Baikie who gave me my first vacation job in 1973 as an undergraduate student. Engr. and Mrs. S. O. Akaiku who gave me enormous support when I was a secondary school student. To them I say thank you very much.

And to my numerous and hardworking students, I don't know where to begin from and where to end, but let it be known that I love you all and I do sincerely appreciate you all. I wish to put some emphasis on my postgraduate students both present and past, most of whom are here and most of whom have become my very close and personal friends. I learnt a lot from you too. God bless you all. And to all other great ABU students here, I thank you for keeping the flag of ABU flying and God bless you too,

I specially thank all the members of my family who have shown me love, care and kindness all along. I appreciate you. And to my relations: Mr. Reuben Jigah, Ali Bello, Dr. Edwin Konto and others. I appreciate our (Bassan-Nge) traditional ruler in Zaria and environs Chief Daniel Menegbe and his wife, Rt Revd (Prof) C. S. S. Bello, Bishop of Zaria Dioceses my brother and friend and his wife. I thank you and I love you all.

My sincere thanks also go to Mal. Saidu Shehu Adamu who typed the manuscript and the corrected drafts at every stage. I found him most efficient and professional. And to the audience, I thank and appreciate you very much for coming for without you this occasion could not have taken place. Do accept my gratitude and God bless you richly.

Thank you all for your attention and patience.

God Bless!

1.1 Preamble

I consider it a great honour and singular privilege to stand before this distinguished body of academic community to deliver this inaugural lecture. It is the 3rd from Faculty of Education, 1st from the department of science education and first to be delivered by a Professor in the field of science education. Traditionally, inaugural lectures are seen as ceremonial occasions during which the academic community of universities formally induct professors into exalted academic and professional office. But in more recent times, this emphasis tended to have broadened to include provision for an opportunity for the professor to pinpoint, analyze and hopefully shed light on the way forward regarding burning issues within the domain of the field in which he/she is a practitioner. For me, this translates amongst other things to the following:

a) To shed light into the academic and research enterprise in which I have had the privilege to practice for, at least, the last three decades.

b) To pinpoint, analyze, discuss and proffer functional recommendations to issues of academic and public interest that are germane to holistic and national development.

c) To bear my mind and consequently expound to this august assembly, and eventually the larger world, my thoughts, academic endeavours and contributions to the field of science education alongside the inherent implications and applications.

1.2 My Journey into the Teaching Profession

Before I attempt to focus attention on the kernel of the lecture, permit me Mr. Chairman, to open a little window, for the purpose of this occasion, to afford a glimpse of my adventure into the teaching profession. It was never in my thought, nor was it my intention least my plan to be a teacher, let alone a professor in the field of teacher – education. I had wanted to, and indeed planned to be a quality – control chemist. Thus when I was admitted, as an undergraduate student into Ahmadu Bello University in 1972, I registered to read Biochemistry. And to put me in a good stead for realizing my dream of becoming a quality-control chemist, I changed in part II of my programme from B.Sc Biochemistry to B.Sc Chemistry. At least, so I thought. I remember, for instance that

in my parts II and III of the programme, some of the chemistry laboratory attendants, especially during our practical classes would throw jokes at me and say, "the way we see you, you may become a teacher...." I usually got angry at such jokes and wished I could throw some acid at them in response! Little did I know that they were being prophetic as you can see to day.

The turning point was during my national youth service which started at the Jimeta secondary school, Yola in 1975, but later in the service year; moved to Government Secondary School (GSS), Hong, both of which are in the present Adamawa State of Nigeria. It was while I was in Hong that the form III chemistry class assigned to me to teach made so much "noise" about the Youth Corper called Mr. Shaibu whom, according to them, simplified for them the learning of chemistry (which they had earlier considered impossible to understand) thereby making it easy and interesting for them to learn. The students formed what I might to-day describe as a "campaign group" who went to the Principal (Mr. Wilbeforce Juta) to ensure that he retained me in the school as a chemistry teacher. After my completion of the Youth service. Indeed, Mr. Juta did all he could to retain me in GSS Hong, first by securing teaching appointment and car loan from the Ministry of education, even before completion of my service period.

It was within this context that the thought began to flow across my mind, for the first time, to consider teaching as a profession since I probably might prove to be an effective one after all. This was then the scenario in which the seed of becoming a teacher was sown in my mind. The seed germinated, gradually grew and eventually choked out my initial thought and dream of becoming a quality – control chemist. It was with this background that I eventually sought employment into Ahmadu Bello University on completion of my Youth Service. I was offered employment as Graduate Assistant after I was considered successful at the interview scheduled for the purpose. I assumed duty at the defunct School of Basic Studies (SBS) in 1976. It was within the years I was in SBS that I gradually moved my career from the field of chemistry to that of science education. And when SBS folded up in 1988, I naturally transferred my services to the science education section of the then department of education. This has been the very brief summary of

my career and professional journey into the teaching profession and specifically into the field of science teacher-education.

1.3 The Structure of my Lecture

This inaugural lecture is organized around the following themes or topics:

1.0 Introduction
2.0 Description of basic concepts: Science, Education and Science Education.
3.0 The maze of students' underachievement in science: Fact of Fiction?
4.0 Does science education research provide a road map to show the way out of the maze?
5.0 Discernible Road maps from Science Education Research Studies.
6.0 Conclusion and Recommendations
7.0 References
8.0 Acknowledgment.

2.0 Science Education: Meaning and Scope

In considering this segment of the lecture it is appropriate, to first focus on each part of the major concepts before we attempt to view them holistically vis-à-vis their relevance to the topic of the lecture. Thus, we should briefly consider; Science, Education and Science Education.

2.1 Science:

Science has been defined by many scholars and science philosophers too many to mention exhaustively. A few examples here will probably suffice. Aliyu (1982) defined science form three perspectives. To a scientist, it is an intellectual activity through which man seeks to understand nature. To the science teacher, science comprise organized and systematized body of knowledge in form of concepts theories and laws. To a layman, science is more-or-less everything, in form of machinery and gadgets that have made life more comfortable for him. He noted that none of these views by themselves represent a holistic definition of science. He thus concluded by giving what he considered a more broad-based

definition which regards science as activities that culminate into testable, falsifiable and verifiable body of knowledge. Bassey (2005) observed that science is both a system of knowledge and the methodological process by which new knowledge is unravelled, thus ensuring the dynamics and growth of science. Furthermore, he conceives of science as a tool for probing and exploring the unknown. Shaibu (1992) defined science as a complex human activity that leads to the production of a body of universe statements called laws and theories which serve to explain the observable behaviour of the universe or some aspects of it.

Science can then be viewed as both an intellectual tool and an organized body of knowledge which carries with it a characteristic way of thinking, attitude, disposition and action. Infact it can be said that there is a scientific way of thinking, a scientific attitude and a scientific way of behaviour and action. There is, therefore a sense in which science can be seen as a culture which influences and even moulds the attitude and behaviour of individuals, communities and indeed nations exposed to that culture. In summary, therefore, science can be viewed as a human enterprise conceived by human mind to enable man explore or investigate, in a controlled and systematic manner his environment with a view to understanding it and thus manage and control it to his advantage ultimately. Indeed, this broad definition of science represents a major philosophical basis for contemporary global emphasis on teaching/learning science to attain scientific literacy for all.

2.2 Education

"Education is a house-hold word which, as we probably know, comes from the Latin word "Educare" which in its literary sense means to lead or to rear. Thus education refers to the process of dissemination, transmission and imparting of ideas, facts, information, culture, social ethos and ethics through a designed process of communication. It is a process of giving, exchanging or sharing of facts, information, ideas, skills, behaviour and attitudes that ultimately leads to noticeable, desirable and enduring behavioural changes in the individual (Gagne, 1986). Therefore, education can be viewed as a complex process of leading or raising individuals along life-long learning experiences. As a life-long process, it is aimed at preparation for life and indeed living. Of

course, life or living means much more than mere existence. Fundamentally it consists in leading a happy, productive and fruitful life. Thus, we can qualify our earlier definition of education to give a more value-oriented one, namely that education is preparation for a happy, productive and fruitful life. This kind of "education for good life" should, in my opinion, focus on and emphasize the following imperatives amongst others, namely social responsibility, job/vocational re-orientation for self-reliance, political and social responsibility and regeneration that breed fair play, justice, equity, responsible citizenship, respect for the dignity, views and values of fellow human beings and commitment to moral and spiritual issues.

From the foregoing, I consider that education for good life as I have so far described constitute a veritable parameter for happy, productive and fruitful living of individuals, communities and nations, indeed developing nations such as ours-Nigeria. I also consider that we, in all probability, now have a functional barometer, from our description, by which we can assess ourselves and perhaps others as to whether or not we, as individuals, communities and a nation (Nigeria), have acquired or in the process of acquiring "education for the good life" I wish to conclude this segment by indicating that our description of the concept of education so far in this lecture provide us with a reliable and veritable instrument by which we can evaluate whether we are passing on to the present generation just any kind of stuff in the name of education or whether we are consciously and deliberately inculcating into them "Education for good life". This may probably be considered as food for thought.

2.3 Science Education

2.3.1 Definition

Science Education can be conceptualized as an integrated field of study comprising such knowledge domains as natural sciences, technology, philosophy, psychology, sociology and history. Basically it is a relevant combination of science, technology, educational theory and practice. According to Ahiakwo (2006), science education cuts across many fields of human endeavour namely, the natural sciences, sociology, philosophy, history, e.t.c He further explained that science education can also be

described as "Education in science". Furthermore, Okeke (2007) described science education as an integrated field of study which considers both the subject matter of science disciplines such as biology, chemistry physics etc. alongside the processes involved in the teaching and learning of science. According to her, there actually exists a thin line between the concepts of science education and education in science. She posited that while the latter basically refers to the understanding and application of scientific concepts and principles, the former deals with the acquisition and development of processes and procedures required in helping others acquire necessary scientific and technological knowledge and the skills required for everyday living in a scientific and technological society.

2.3.2 Perspectives of Science Education

Science education can therefore be viewed from a number of stand-points which include the following perspectives.

a) **Perspective of Curriculum and instruction:** which deals with theories, principles and practices of curriculum design and implementation.

b) **Philosophical perspective:** This considers science education to have idealistic or pragmatic characteristics.

c) **Perspective of Pedagogy:** This involves all the processes and procedures for teaching and learning of science in the classroom situation. This lecture is predominantly located within this perspective.

d) **Perspective of the Society:** This perspective moves science education beyond the classroom environment to the larger society. This essentially involves the application of scientific knowledge for the improvement of the living conditions of humankind.

Thus, science education has a multi-dimentional character, relatively extensive and complex in nature and also of high utilitarian value and importance. Shaibu (1993), and Shaibu (2002) among others, have in many ways described the all encompassing nature of science education. Operationally therefore, science education can be considered to largely reside at two major levels, namely, at the level of educational institutions and at the level of the larger society. In all cases,

it involves a dynamic and interactive equilibrium among humans, environment and materials.

2.3.3 Scope of Science Education

The scope of science education can largely be described by its core aims and goals. Oriafor (1997) listed a number of the aims and objectives of science education. These include the following:

a) Relevance and importance of the domains of educational endeavour which covers the cognitive, physco-motor and affective.
b) To inculcate and facilitate critical and flexible thinking process and familiarization with the spirit of science.
c) To prepare individuals for vocations in science.
d) To serve as springboard for generating empirical evidence for rational judgment on socio-political and economic issues that are germane to national growth and development.

2.3.4 Delineation

Mr. Chairman, this lecture is focused on the pedagogic perspective earlier highlight and this is in alignment with the first aim of science education listed above namely, the domains of educational endeavours covering the cognitive, psychomotor and affective aspects of knowledge, with particular emphasis on the cognitive domain. The lecture is furthermore focused on the secondary level of education. This is primarily because most of my research interest and efforts have been at this level of education. Additionally, most of the studies herein reported, are for reasons of specialization, in science education studies as they relate to teaching and learning of chemistry in particular.

3.0 The Maze of Students' Academic Underachievement in Science: Fact or Fiction?

Background

The Nigerian educational system has passed through many changes and curricular invocations in the last few decades. These include, for example, introduction of the Universal Primary Education (UPE) in 1976. This brought about unprecedented enrolment of pupils into primary schools. Okebukola (1984) observed that the liberalization of secondary school education,

beginning especially from 1979 sharply increased student's enrolment into this level of education.

Secondly and equally importantly, the introduction of the Universal Basic Education (UBE) in September 1999 further prompted high level of pupils enrolment into the secondary schools across the country. These fundamental changes brought along with them phenomenal challenges of resources, logistics and implementations which many scholars and educationists regard as major contributor to the problem of students' academic underachievement which has aroused nagging national problem and concern. Bonnie (2003) for example, observed that inadequate planning of the UPE and UBE resulted in an astronomical increase in pupils' enrolment into the primary schools and cumulatively into the secondary schools with passage of time. Furthermore, Aliyu (1999) reported that poor planning and implementation led to inadequate and in some cases, lack of instructional materials, overcrowded classrooms, poor physical facilities, unsuitable psycho-social environment for learning in the schools. The overall effects of these ultimately resulted, willy-nilly, into unquantifiable stress and strain in academic activities in the schools. And these consequently made significant contributions to students' poor academic achievement which generally manifest as high level of failures in secondary school examinations conducted by West African Examination Council (WAEC) and National Examination Council (NECO). From the foregoing, the issue of students' under achievement in science and the factors that prompt and sustain them have been both historical and systemic. It will be a reasonable scientific conjecture to suggest that if the Government of Nigeria at the various levels have had the political and leadership will to tackle the antecedent problems that brought about students' academic underachievement alongside provision of appropriate public psychological orientation, the Nigerian educational system would have been put on the right track in the same manner that were done in developed and developing countries like India, Malaysia, Japan, etc.

Many science education scholars and curriculum specialists including this lecturer, have shown a great deal of interest and concern about the high level of students' underachievement in science. They further showed interest in finding out such factors that might be responsible for or contribute to the observed consistent pattern of low students' achievement which is detrimental to education generally and the desired move towards scientific literacy for all and technological breakthrough for sustainable national development. Some of the factors identified include the following:

i. Large class size-Ivowi etal (1992);

ii. Overload curriculum – Adeyegbe (1993)
iii. Use of inappropriate instructional strategies – Ajeyalemi (1983)
iv. Gender-related factors – Shaibu and Mari (1997)
v. Quality of pre and in-service teacher training. Shaibu and Usman (2002)
vi. Motivational support by parents and teachers. Shaibu and Iroegbu (2002)
vii. Lack of teaching and learning materials/facilities. Awolade (2005).

In an attempt to further provide emperical evidence to highlight the fact that students underachievement in science is a consistent reality that is living with us, I now refer you to the following statistics showing the profile of students' academic achievement in the Senior Secondary School Certificate Examination conducted by the West African Examination Council (WAEC) for the period of time covering 2005-2012 in science subjects as shown in Tables 3.1-3.6. Tables 3.1-3.3 show the profile of the national results covering the whole country while Tables 3.4-3.6 cover Kaduna State alone for the same period of time.

Statistics of Candidates Performance in Biology, Chemistry and Physics in the May June 2005-2012 WASSCE in Nigeria

Table 3.1: Students' Academic Achievement in Biology, Nation Wide (2005-2012)

Year	Total No of Cands that Entered	Total No of Cands that Sat	No Absent	No of Cands With C6 and Above	% of Cands with C6 and above	Letter Grade
2005	1072607	1051557 98.04	21050 1.96	375850	35.74	F
2006	1162046	1137131 97.86	24865 2.14	559854	49.23	D
2007	1261971	1238163 98.11	23808 1.89	4132211	33.37	F
2008	1285048	1259965 98.05	25083 1.95	427644	33.94	F
2009	1364655	1340206 98.21	24449 1.79	383112	28.58	F
2010	1325408	1300418 98.11	24990 1.89	645633	49.64	D

2011	1532770	1505199 98.20	27571 1.8	579432	38.49	F
2012	1687788	1646150 97.53	41638 2.47	587044	35.66	F

Source: WAEC Office, Lagos.
Note: The letter grades were added by the Author.

Table 3.2: Students' Academic Achievement in Chemistry Nationwide (2005-2012)

Year	Total No of Cands that Entered	Total No of Cands that Sat	No Absent	No of Cands with C6 and Above	% Of Cands With C6 and Above	Letter Grade
2005	357658	349936 97.84	7722 2.16	178274	50.94	C
2006	389462	380104 97.60	9358 2.40	170670	44.90	E
2007	432230	422681 97.79	9549 2.21	194284	45.96	D
2008	428513	418423 97.65	10090 2.35	185949	44.44	E
2009	478235	468546 97.97	9689 2.03	204725	43.69	E
2010	477573	465643 97.50	11930 2.5	236059	50.69	C
2011	575757	565692 98.25	10065 1.75	280250	49.54	D
2012	641622	627302 97.77	14320 2.23	270570	43.13	E

Source: WAEC Office, Lagos
Note: The letter grades were added by the author

Table 3.3: Students' Academic Achievement in Physics Nationwide (2005-2012)

Year	Total No of Cands that Entered	Total No of Cands that Sat	No Absent	No of Cands with C6 and Above	% of Cands with C6 and Above	Letter Grade
2005	351778	344411 97.91	7367 2.09	142943	41.50	E
2006	383477	375824 97.94	8653 2.25	218199	58.05	C

2007	427398	418593 97.94	8805 2.06	180797	43.19	E
2008	424893	415113 97.70	9780 2.30	200345	48.26	D
2009	474887	465636 98.05	9251 1.95	222722	47.83	D
2010	475414	463755 97.55	11659 2.45	237756	51.27	C
2011	573043	563161 98.28	9882 1.72	360096	63.94	B
2012	638834	624658 97.78	14176 2.22	429415	68.74	B

Source: WAEC Office, Lagos
Note: The letter grades were added by the author

Table 3.4: Students' Academic Achievement in Biology Kaduna State only (2005-2012)

Year	Total No of Cands that Entered	Total No of Cands that Sat	No Absent	No of Cands With C6 And Above	% Of Cands with C6 and Above	Letter Grade
2005	38330	37594 98.08	736 1.92	11340	30.16	F
2006	45312	44331 97.84	981 2.16	18340	41.37	E
2007	52699	51539 97.80	1160 2.20	15387	29.85	F
2008	55015	53946 98.06	1069 1.94	17378	32.21	F
2009	55776	54729 98.12	1047 1.88	16765	30.63	F
2010	64379	63361 98.42	1018 1.58	33015	52.10	C
2011	79885	78616 98.41	1269 1.59	32474	41.31	E
2012	93360	91646 98.16	1714 1.83	33549	36.60	F

Source: WAEC Office, Lagos
Note: The letter grades were added by the author

Table 3.5: Students' Academic Achievement in Chemistry Kaduna State only (2005-2012)

Year	Total No of Cands that Entered	Total No of Cands that Sat	No Absent	No of Cands with C6 and Above	% of Cands with C6 and Above	Letter Grade
2005	12645	12426 98.27	219 1.73	5571	44.83	E
2006	15023	14734 98.08	289 1.92	6869	46.62	D
2007	17735	17420 98.22	315 1.78	7811	44.84	E
2008	18386	18039 98.11	347 1.89	6493	35.99	F
2009	19461	19129 98.29	332 1.72	9522	49.77	D
2010	23725	23190 97.74	535 2.26	14188	61.18	B
2011	31414	30933 98.74	481 1.53	17752	57.38	D
2012	37875	37347 98.61	528 1.39	17062	45.68	D

Source: WAEC Office, Lagos
Note: The letter grades were added by the author

Table 3.6: Students' Academic Achievement in Physics Kaduna State only (2005-2012)

Year	Total No of Candidates that Entered	Total No: of Candidates that Sat	No: Absent	No: of Candidates With C6 and Above	% of Candidates with C6 and Above	Letter Grade
2005	12496	12285 98.31	211 1.69	4437	36.11	F
2006	14883	14618 98.22	265 1.78	9070	62.04	B
2007	17593	17323 98.47	270 1.53	5899	34.05	F
2008	18296	17954 98.13	342 1.87	8122	45.23	D
2009	19461	19129 98.29	332 1.71	9522	49.77	C
2010	23621	23116 97.86	505 2.14	15077	65.22	B
2011	31325	30810 98.36	515 1.64	12902	41.87	E
2012	37772	37257 98.64	515 1.36	27460	73.70	A

4.0 Does Science Education Research Provide a Road Map to Show the Way Out of the Maze?

4.1 Introduction

In choosing the topic of this lecture, I have used two metaphoric expressions "Maze and Road Map". The first i.e. "Maze" is purposively used to describe the phenomenon of students' underachievement in science. This is because the situation of underachievement, its existence and the factors that both prompt and support its prevalence are complex, complicated, pervasive and interwoven. The second, namely "Road map" is used to indicate that there have been a great deal of research efforts including those by this lecturer that are carried out towards ameliorating the nagging problem of students' underachievement in science.

No single lecture or presentation can claim to deal with the issues comprehensively or exhaustively. I have thus chosen some categories of factors that have been seen to play significant roles in arousing and sustaining students' underachievement in science and the research efforts that attempt to provide the way forward in the circumstances. These are as follows:

1. Teacher and student factors
2. Gender – related factors
3. Parents' and Teachers' factors
4. Curriculum-related factors
5. Instructional Strategy-related factors.

4.2 My Contributions to Research Efforts that Attempt to Show the Way Out of the Maze

4.2.1 Teacher and Student Factors

The teacher and the central role that he/she plays in the education industry is pertinently driven home by the declaration contained in a position paper (NERDC, 1980) which observed interalia that:

> ..... teachers are the main determinants of quality in education. If they are apathetic, uncommitted, uninspired, lazy, unmotivated, anti-social, the whole nation is

doomed. If they are ignorant and impart wrong knowledge, they become not only useless, but dangerous. The kind of teachers trained and posted to schools may well determine what the next generation may be.

Topics Difficulty in Chemistry: Students' and Teachers' Perception

In this study, (Shaibu, 1988) investigated the level of conceptual difficulty at which science students perceive/estimate chemistry topics presented to them. The same topics were also given to their teachers to estimate their respective conceptual difficulty from the "Eye" of their students.

The sample comprised 150 chemistry students of the defunct School of Basic Studies, Ahmadu Bello University. Average age of the sample, which was obtained by simple random selection was 18 years. Data were collected using two instruments, namely students' and teachers' questionnaire each with reliability coefficient of r = 0.75 and 0.78 respectively.

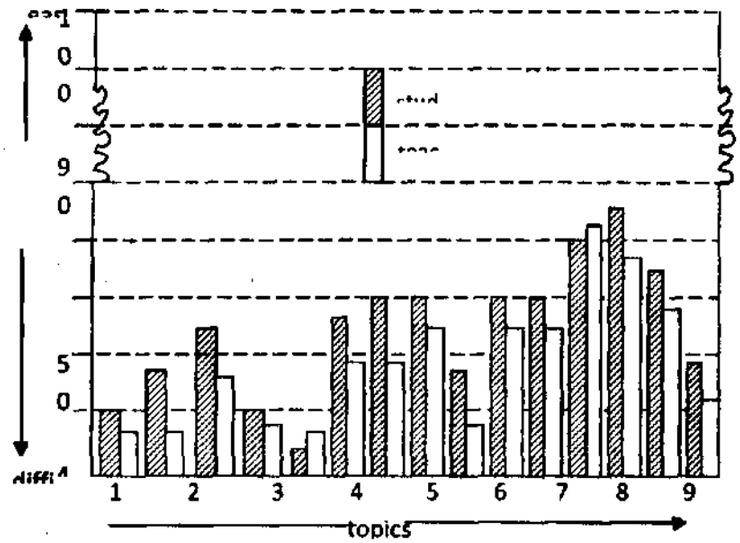
The results are shown in Tables 4.1(a) and 4.2(b).

Table 4.1(a) Distribution of Students and Teachers' Responses in % Teachers Responses in Parenthesis.

S/N	Topics	Difficult	Moderate	Easy
1	Names of organic compounds (nomenclature): generally, the IUPAC system	10.0 (4.7)	28.0 (24.6)	62.0 (70.7)
2	Structure of molecules: arrangement of atoms in molecules leading to the concept of structural isomerism	14.6 (4.7)	45.4 (41.3)	40.0 (54.0)
3	Conformations of organic molecules]: rotation about single C-C bonds, eg eclipsed and staggered conformation is ethane	25.3 (18.8)	30.4 (34.9)	44.3 (46.3)
4	Functional groups: recognition and naming of functional groups, eg >C = O carbonyl group, NH_2 amino group	10.7 (9.4)	29.0 (24.3)	60.3 (66.3)
5	Atomic structure: electronic configuration of atoms underlying an understanding of organic reactions	5.3 (9.4)	40.7 (36.3)	54.0 (54.3)

6	Symbolisms, eg resonance, curved arrows, partial and full charges	25.3 (18.8)	39.3 (41.3)	35.4 (40.0)
7	Bonding in organic molecules: electronic concept of covalent bonding, (Lewis theory)	30.0 (18.8)	24.8 (37.0)	45.2 (44.2)
8	Stereochemistry, eg hexagonal, triangular and planar molecules-	30.0 (23.5)	40.0 (38.3)	30.0 (36.2)
9	Rules and principles, eg Markownikov's rule transition state theory	16.0 (9.4)	37.4 (28.9)	46.6 (60.7)
10	Reaction of organic compounds, eg reactions of alcohols, hydrocarbons, amines, esters, etc	30.0 (23.5)	48.0 (48.9)	22.0 (27.6)
11	Named organic reactions, eg Wurtz reaction, Cannizzaro reaction, Hofmann reaction	30.0 (23.5)	28.3 (31.0)	41.7 (45.5)
12	Reaction mechanisms; description of bond-breaking and bond-making processes involved in organic reactions	40.0 (42.3)	42.0 (39.4)	18.0 (18.3)
13	Organic synthetic pathways interconversion of organic compounds, eg oxidation of alcohols to carboxylic acids; reduction of carbonyl group to hydrocarbons	45.3 (37.6)	44.4 (45.0)	10.3 (17.4)
14	Energetics of organic reactions; explanation of energy profile of organic reactions, eg the concepts of free energy change (ΔG) enthaphy change (ΔH), chemical equilibria (K)	35.2 (28.5)	46.0 (51.9)	18.8 (19.6)
15	Calculations involving organic compounds, eg calculating empirical and molecular formulae from numerical data	20.0 (14.3)	45.0 (35.9)	35.0 (49.8)

Table 4.1(b): Barchart Distribution of Students' and Teachers' Responses



The results show, among other things that:

(i) The students found more than half of the topics conceptual difficult (Table 4.1a)

(ii) The teachers tend to consistently underestimate the conceptual difficulties experienced by their students (Table 4.1b).

(iii) The teachers tend to estimate the level of conceptual difficulties of the topics from a teaching, rather than from a learning perspective.

A Chi-square test of the response distribution ($\chi 2 = 5.42$) showed that the students'/teachers' perception disparity is statistically significant ($P \leq 0.05$).

Educational Implications

A major implication of these findings for efficient teaching and learning science and to mitigate students' underachievement in science is that science teachers should develop the capability and empathy to operate at similar or possibly the same conceptual frequency with their students. Earlier studies, for example, Arzi et al

(1984), and Bojezuk (1982) also showed that teachers in non – African settings also have similar tendencies of not having enough grasp of the conceptual difficulties that their students experience in the process of teaching and learning science.

Achievement of Senior Secondary School Students in Savoy's Concepts as a Correlate of their Achievement in Balancing Chemical Equations

Chemical equations can be described as symbolic and quantitative representations of the changes that occur in the process of chemical reactions based on the principle that matter is neither created nor destroyed during chemical reactions. For example, the chemical equation: $xA+yB \rightarrow pC+qD$ shows that A and B are the reactants while C and D are the end products. Also x,y,p and q represent the relative numbers of moles of reactants and products i.e. the stoicheometric coefficients.

Studies have shown that the ability required to write chemical equations correctly is not a simple one (Suderji, 1983, Savoy, 1988). Schmidt (1984) and Bello (1988) reported that students' persistent difficulties in solving stoicheometric problems are partly associated with their inability to write chemical formulae and present chemical equations correctly.

Savoy (1988) identified 8 concepts which he considered to serve as the relevant subordinate concepts which underline the understanding of and thus the ability to balance chemical equations correctly.

They are the following:

(1) Atoms and atomicity
(2) Molecules and molecular formulae
(3) Atomic structure and bonding
(4) Valency
(5) Use of brackets
(6) Radicals
(7) Subscripts and coefficients
(8) Molar ratio

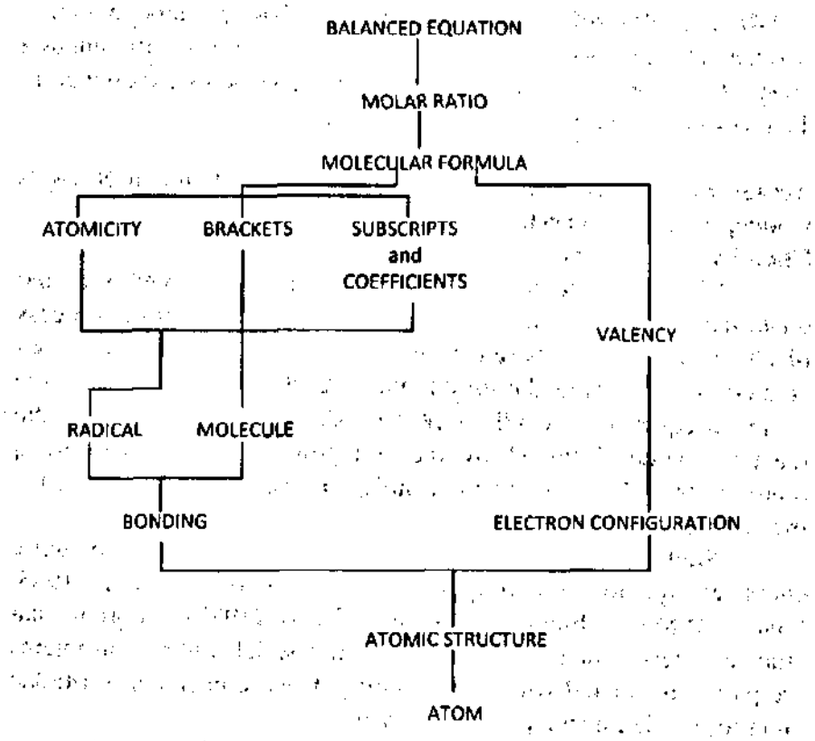


Fig 1. Savoy's Conceptual Hierarchy of Concepts needed to balance chemical equations
Source: Savoy (1988)

Shaibu (2002) investigated senior secondary school students' (SS II) achievements in Savoy's concepts and the relationship between these and their achievements in balancing chemical equations. The sample, obtained through stratified random selection was 180 comprising 115 male and 65 female students. Their average chronological age was 17 years. Two instruments were used for data collection. These were Chemical Concepts Achievement Test (CCAT and Chemical Equation Achievement Test (CEAT). While CCAT measured the students' achievement in Savoy's identified 8 concepts CEAT measured their achievements in balancing chemical equations that require the knowledge of the underlying Savoy's concepts. Using the method of split – half, adjusted by the

Spearman–Brown prophecy formula, the reability coefficient of CCAT was found to be r = 0.82 while that of CEAT was r = 0.78. CCAT was rendered in the multiple choice (MC) format, comprising 30 items while CEAT was in free – responses (F.R) format comprising a total of 17 items. The data collected were computer – analyzed using the SPSS statistical package.

Results

The results are shown in Tables 4.2(a) – 4.2(c)

Table 4.2(a) Students' Achievement in Savoy's Chemical Concepts

S/N	Chemical Concepts	N	No. of Subjects Scoring 50% or above of the maximum score	%
1	Atoms and Molecules	180	125	70.3
2	Atomicity	180	90	50.0
3	Valency	180	70	38.8
4	Subscript	180	55	30.6
5	Brackets	180	50	27.8
6	Coefficients	180	45	25.0
7	Radicals	180	35	19.3
8	Molar Ratio	180	30	16.6

Table 4.2(b) Students' Achievement in Balancing the Chemical Equations

Task	N	No. that Achieved 40% or above of the maximum score	%
Balancing of the given chemical Equation	180	18	10.0

Table 4.2(c) Correlation Between Students' Achievement in CCAT and CEAT.

Test	N	$\bar{X}$	Std Dev	r	r^2	df	p
CCAT	180	17.10	15.12	0.70*	0.49	178	0.035
CEAT	180	19.66	18.20				

***Significant** $P \leq 0.05$

Table 4.2(a) shows that out of the eight (8) concepts, it was only in two that 50% or more of the students scored up to 50% or above of the maximum score. This is indicative of students' poor

understanding of Savoy's concepts which are basic and supportive of the ability to balance chemical equations.

Hines (1990) also reported that secondary school students in Botswana in South Africa had a low – level understanding of Savoy's concepts. Additionally, Schmidt (1984) found that secondary school students in Germany had conceptual difficulties with quantitative relationships in chemistry and this tended to affect their achievement in balancing chemical equations.

Table 4.2(b) shows that only 18 students (10%) were able to attain 40% or more of the maximum score given in the task of balancing chemical equations they were given in the study. This poor achievement tended to have logically derived from their poor understanding of the underlying pre-requisite Savoy's concepts as indicated in Table 4.2(a).

Table 4.2(c) shows the Pearson's Product Moment Correlation coefficient between the students' achievement in Savoy's concepts and their achievement in balancing the chemical equations. The correlation, $r = 0.70$, indicates a strong and significant relationship between understanding of Savoy's concepts and ability to balance chemical equations. Further analysis shows that the coefficient of determination $r^2 = 0.49$. This shows that 49% of the variance in the ability to balance chemical equations is accounted for by students' functional understanding of stipulated Savoy's concepts.

Findings

1. The students achieved properly in the tasks involving Savoy's chemical Concepts.
2. The students also achieved poorly in the tasks involving balancing of chemical equations.
3. There is statistically significant relationship between achievement in Savoy's chemical concepts and achievement in balancing chemical equations.
4. Forty nine percent (49%) of the variance in balancing chemical equations is accounted for by the students' functional understanding of Savoy's chemical concepts as pre-requisite knowledge base.

Implications for Education

The assumption, often made implicitly by science teachers that students will along the line of instruction develop required skills and ability to perform target tasks needs a re-examination as such assumption is not supported by this empirical finding.

Relationship between Conceptual Knowledge and Problem – Solving Proficiency of Science Students: Pedagogic Implications

The development in students of the ability to solve problems is major goal in science teaching and learning (Gagne, 1985). Two types of knowledge have been identified to underline problem – solving proficiency. These are conceptual and procedural or strategic knowledge. The former refers to knowledge of concepts, laws and theories of a particular domain presented to students in the course of instruction while the latter refers to the knowledge of general heuristics that underline the ability to solve problems using acquired conceptual knowledge. Problem–solving facility is enhanced where the *structure* and *hierarchy* of acquired conceptual knowledge is both adequate and relevant.

Shaibu, (1992) investigated the relationship between science students' possession of conceptual knowledge and their ability to utilize such to solve related problems. The theoretical framework of the study was based on Ausubel's (1968) theory of meaningful learning. A major plank of the theory is that where students do not possess requisite subsumers, they resort to learning by rote.

The structure and hierarchy of concepts (knowledge) acquired in that way is found to be, often most unhelpful for students to solve problems. The study attempted to identify the relationship if any between the conceptual knowledge of science students in Nigeria and their ability to solve problems based on such knowledge as necessary pre-requisites. Specifically the study sought to:

(a.) find out if the students possessed the relevant conceptual knowledge they were previously exposed to in their course of instruction.

(b.) find out, based on (a) above, if the students were successful in solving the related problems.

(c.) determine the relationship, if any between students' conceptual knowledge and their problem-solving proficiency.

The sample which was obtained across the country (Nigeria) through simple random sampling comprised a total of 190 science students offering chemistry as one of their three main subjects. They were selected from five schools of the defunct Schools of Basic Studies equivalent to the current SS3 secondary school students. Two tests, multiple choice and free-response formats (labeled tests A and B respectively) were used to collect data. Test B was structured on test A, meaning that test B required the knowledge of test A to solve the problems contained therein.

The maximum score obtainable in test A = 40 while the maximum score for test B = 43 which depended on the total number of operational steps required to solve the five problems. The data collected were analyzed using the MINITAB statistical package.

Results

The results are shown in Table's 4.3(a)-4.3(f).

Table 4.3(a) Some Statistical Properties of Tests A and B

Statistical Properties	**Test**	
	A	**B**
Sample size (N)	190	190
Sum of Scores ($\sum x$)	3695	1643
Mean Score ($\bar{x}$)	19.45	8.65
Std. Dev (s)	5.05	3.95

Test A (Max Score = 40) Test B (Max Score = 43)

Tables 4.3(b) and 4.3(c). Facility Indices of Items in Tests A and B respectively

Table 4.3(b) Facility Indices of Items in Test A		**Table 4.3(c) Facility Indices of Items in Test B**	
> 0.50	20	1	0.44
> 0.30 ≤ 0.49	15	2	0.41
		3	0.52
< .30	05	4	0.70
Total	40	5	

Table 4.3 (c) Comparison Between Students' Achievement in Tests A and B

Tests	N	$\bar{X}$	Sd	SEd	t-value	df	P-value
A	190	19.45	5.09				
B	190	8.65	3.95	0.47	22.98*	378	0.02

*Significant at $P \leq 0.05$

Table 4.3 (d) Relationship Between the Students' Academic Achievement in Tests A and B

Tests	N	$\bar{X}$	Sd	r	r^2
A	190	19.45	5.05		
B	190	8.65	3.95	0.45	0.20

Table 4.3 (f) Simple Regression Analysis of the Students Scores in Tests A and B

Tests	N	$\bar{X}$	Sd	No reaching Predicted score	% reaching predicted score	Coefficient of Regression
A	190	19.45	5.05			
B	190	8.65	3.95	80.	42.0	0.35

The following comprise the major findings of the study:

(i) The students possessed most of the conceptual knowledge required to solve the problems they were confronted with.

(ii) The students were unsuccessful in solving the problems, not withstanding that they possessed the relevant conceptual knowledge.

(iii) There is a weak connection between the students' possession of conceptual knowledge and their problem-solving proficiency. The variance of the latter accounted for by the former is 20% only.

Pedagogic Implication

The view, often held by science teachers that students would develop desired problem – solving skills and capabilities if only exposed to instructions in relevant conceptual knowledge should be approached cautiously, especially that such tacit professional

assumption is found, from this study, not to be viable or tenable as a meaningful instructional strategy.

A structured Text Approach to Remediating Difficult Concepts in the Teaching and Learning of Science in Schools

Remediation of problem – solving difficulties is shown, from literature to have been undertaken by a number of approaches. Examples include: -

(a) Specific teaching of problem – solving skills (Reif et al, 1986)
(b) Guidance and counseling method (Herron, 1984)
(c) Classroom interactive approach (Adeyegbe, 1985)
(d) Structured text approach (Shaibu, 1998)

These are generally aimed towards promotion of students' understanding of the difficult concepts. The assumption is that improved understanding of science concepts enhances the ability to command knowledge (Ebel and Frisbie, 1986) which in turn brings about proficiency in students' problem-solving capabilities.

Shaibu (1998) investigated the efficacy of printed structured text in remediating learning and problem – solving difficulties of science students. It involved printed texts in modules (topics) each addressing specific conceptual difficulties that have been previously identified through application of diagnostic tests. The choice of the approach is based on such considerations as its, simplicity, flexibility and adaptability. The study was based on the constructivist paradigm, the thrust of which is that learners process information verbal, symbolic or sensory in order to find meaning, explain natural phenomena and thus construct their knowledge (Drive and Bell, 1986; Osborne and Wittrock, 1983). The immediate implication of this model of learning for instruction in science is that:

(a) the learner is an active participant in the learning process rather than a passive recipient of information or knowledge.
(b) it serves to explain, at least in part, sources of pre-conceptions that students bring to science class, how misconceptions develop and why they are sometimes difficult to correct.

(c) it gives insight into how and why students often find some science concepts difficult to understand and hence incapable of applying them in appropriate situations.

The sample comprised a total of 50 science students of senior secondary school (Year II) Zaria Metropolis. Their average chronological age was 16 years. The remedial package (i.e. the printed structured text) which comprised ten topics were administered to the sample, who had participated in an earlier diagnostic study that showed they were deficient in dealing with chemical problem-solving tasks they were previously exposed to. The conceptual difficulties they haboured were diagnosed using paper – and – pencil tests and also from analysis of protocols collected from the students. The remedial treatment lasted 5 weeks i.e. two topics of the remedial package per week. The design of the study was quasi-experimental involving pre-posttest/matched group design.

Results

Table 4.4(a) Some Statistical Properties of the Results

Variables	Pretest		Posttest	
	EG	CG	EG	CG
Sample Size (N)	25	25	25	25
Sum of Scores ($\sum X$)	219.00	231.00	409.00	261.00
Mean Score ($\bar{X}$)	8.76	9.24	16.36	10.44
Standard Deviation (Sd)	4.10	3.28	6.78	4.74

Table 4.4 (b) Comparison of the Pre and Post test Scores of the Experimental and Control Groups

Variables	Pretest $\bar{X}$	Sd	Post test $\bar{X}$	Sd	SEd	t-value	df	P-value
EG	8.7	6.78	16.36	6.50				
CG	9.24	4.44	10.43	4.20	1.08	3.46*	48	0.01
SEd	1.02		1.67		*Significant at $P \leq 0.05$ (Between Groups Comparison)			
t-value	0.94**		3.55*					
df	48		48					
P-value	0.13		0.03					

* **Significant** at $P \leq 0.05$ (EG vs EG)

** **Not Significant** at $P \leq 0.05$ (CG vs CG)

(Within Groups Comparison)

Findings

(a) The Academic achievement of both the experimental group (EG) and the control group (CG) generally improved from pre-to post test.

(b) The academic achievement of the EG at the posttest level using within-group comparison, was found to be statistically significant at $P \leq 0.05$ and $df = 48$ while that of the CG under the same conditions was found not to be statistically significant. It should be noted that both groups were equivalent before the treatment intervention.

(c) The posttest academic achievement of the EG was found to be statistically superior to their achievement at the pretest level while for the CG, their academic achievement at the posttest level (though improved) was not statistically higher than that of their pretest.

Implications of the findings for Education (Teaching and learning)

The totality of the findings (a-c) strongly suggest that science students' conceptual difficulty that often manifest as observable underachievements can be remediated to a tolerable level if the appropriate psycho-social, professional expertise and teacher-motivation are in place.

4.2.2 Gender-related Factors in Students' Academic Achievement

Introduction

There are many studies reported in literature which show that gender, as a reality of life and gender-related differences as variables have exerted significant influence on teaching and learning of science, and thus academic achievement in science. While the concept of sex and gender tend generally to be used interchangeably, they do not refer to the same thing. For example, while sex refers to the fact of being either male or female in a biological sense, gender refers to qualities of masculinity or feminity which are most often used within traditional or cultural contexts.

Studies in science education have shown that gender issues and practices tended to have negatively affected the female students

in terms of access, participation and achievement in science. Okeke (2000) reported that females are under-represented, indirectly made to lose interest and thus underachieve in science. Two major categories of factors have been fingered to be at play, namely out-of-school and within – school factors. Out of school factors include methods of upbringing that tend to make females feel their role is in the kitchen and that they are to be seen and not heard. Within-school factors include the following:

(a) Public perception of science which, willy–nilly portrays science as a masculine discipline dominated by the male human kind.

(b) Gender bias in curricular materials: In most instances when examples/illustrations are given in text books it's mostly men that are used. (Erinosho, 1997). Other studies outside Nigeria indicate similar trends. for example (Biachini, 1993).

(c) Science teaching strategies: Studies, for example Njoku (2006) have shown that both the overt and covert pedagogic behaviour of teachers tend to favour the boys more often, than the girls. The general effect of these is to dampen the interest of girls and possibly decrease their academic potentials and ultimately their achievement; and that removal of gender biases in science curriculum and instruction helps to improve academic achievement of girls. It was within this theoretical framework that Shaibu and Mari (1997) investigated gender–related differences of junior secondary school students' understanding of science process skills.

The Study was entitled **Gender–related Differences in the Understanding of Science Process Skills Amongst Junior Secondary School Students**

Science process skills are intellectual tools together with learned capability that scientists use as self-management procedure in carrying out their scientific activities (Gagne, 1986). During the last two decades or so, science educators have advocated that the processes of science should be taught as integral part of the science curriculum. They have argued that acquisition of science process–skills should be a major goal of science education. It has been found that the use of science process – skills as an instructional strategy is viable and help to improve academic achievement (Awodi, 1984).

Campbell (1979) identified two aspects of science process skills which are called the basic science process skills and integrated science process skills. These are listed below:

Basic Science Process Skills:

a) Observing
b) Classifying
c) Inferring
d) Measuring
e) Communicating
f) Predicting

Integrated Science Process Skills:

a) Making operational definitions
b) Formulating questions and hypotheses
c) Experimenting
d) Interpreting Data
e)
f) Formulating models and predictions.

Two instruments were used for data collection. These are the Inventory of Science Processes (IOSP) and the Test of Practicals Skills (TOPS). While IOSP was used to measure the subjects' understanding (achievement) in science process skills, TOPS was used to measure their ability to use the science process skills they possessed to solve given problems which rely on the understanding of science process skills. The two instruments IOSP and TOPS have reliability coefficients of 0.84 and 0.78 respectively. IOSP was adapted from Nay (1987) while TOPS was designed by the researchers.

The nine science process skills tested during the study are as follows:

a) Observing
b) Measuring
c) Classifying

d) Formulating hypotheses
e) Experimenting
f) Interpreting data
g) Communicating information
h) Making inferences
i) Predicting

The population comprised junior secondary school students, classes 1 – 3 in Zaria and Sabon Gari Local Government Areas of Kaduna State. A total of 5 co-educational, 3 male and 3 female school were selected purposively. Stratified random sampling was used to select samples from the co-educational schools, while simple random sampling was used to obtain samples from the single – sex schools. A total of 30 students (10 from JSS 1, 2 & 3 each) were selected from each of the 11 schools to give a total of 330 sample size. Their average chronological age was 13.5 years. The two instruments were administered to the subjects through face-to-face contact by the researchers. The data collected was analyzed using the Statistical Package for Social Sciences (SPSS) software. The study sought to find out:

(a) the level of understanding of science process skills amongst male and female students in the population covered by the study.
(b) if junior secondary school boys and girls exposed to NISP curriculum differ significantly in their understanding of science process skills.
(c) if junior secondary school boys and girls exposed to NISP curriculum differ significantly in their ability to use their understanding (knowledge) of science process skills to solve related problems in science.

Results

The results obtained are shown in Tables 4.5 (a) – 4.5

Table 4.5 (a). Some Statistical Properties of IOSP Scores

Variables	JSS I	JSS II	JSS III
N	110	110	110
Range (%)	8 – 50	8 – 60	23 – 69
Mean Score (X)	29.4	30.60	38.10
Std Dev.	10.20	8.50	8.30

Table 4.5 (b). Some Statistical Properties of TOPS Scores

Variables	JSS I	JSS II	JSS III
N	36	36	36
Range (%)	6 – 31	10 – 29	5 – 44
Mean Score (X)	15.30	18.40	26.30
Std Dev.	5.60	4.80	8.70

Table 4.5 (c) t-test Analysis of Male and Female Mean Scores in IOSP

Variables	N	$\bar{X}$	SD	df	t-value	P
Male	185	30.50	10.50			
Female	145	33.80	9.30	328	3.71*	0.024

* significant at $P \leq 0.05$
Note Max. Score = 70

Table 4.5 (d) t-test Analysis of Male and Female Means Scores in TOPS

Variables	N	$\bar{X}$	SD	df	t-value	P
Male	65	19.40	7.30			
Female	43	20.60	8.60	106	0.59	0.56

t-value is not significant at $P \leq 0.05$
Note: Max. Score = 60, and a total of 108 subjects out of 330, randomly selected were used in this phase that involved practical activities.

Findings

The following comprise the major findings from this study:

(i) The students (both male and female) possessed low level understanding of science process skills as can be seen from their mean scores in IOSP (Table 4.5(a)

(ii) The female students had a significantly higher understanding of science process skills compared to their male counterparts (Table 4.5(c)).

(iii)Junior Secondary School male and female students exposed to science curriculum material (NISP) do not differ significantly in their ability to use possessed knowledge of science process skills to solve related problems.

Implications for Pedagogy

(i) The higher achievement of the girls over the boys in the Inventory of Science Processes test may be due to social and cultural influences which tend to make girls to be more careful, more observant, and also to make use of their eyes and ears (and less of their lips) in comparison to boys. Science teachers need to bring these sort of gender-related characteristics on board their instructional plan and behaviour.

(ii) Even though the female students had better understanding of the science process skills (Table 4.5(c) they were unable to use such knowledge to solve related problems and thus gain similar superiority over their male counterparts as was the case in IOSP. This portrays existence of weak connection between declarative and strategic knowledge of the students. Science teachers need to take appropriate pedagogic steps to close such undesirable gap between students' declarative and strategic knowledge. This calls for patience, experience and expertise on the part of science teachers.

(iii) The generally – held omnibus notion that boys achieve better than girls in science needs a re-appraisal, at least for purposes of pedagogy.

4.2.3 Parents' and Teachers Motivational Factors

Introduction

Studies have shown that parents' motivational support for their children/wards constitute a vital category of motivational factors in students' learning of science. For example, Igwue (1990) found from his studies carried out in Kano State that the background of parents, in terms of social, economic and cultural settings have substantial influence on the motivational level of their children/wards. Studies have also shown that science teachers serve as veritable source of motivation for their students (Skinner and Belmont, 1993). They reported that teachers' motivational support help to foster the fulfillment of some basic psychological needs of the students.

It was against this theoretical background that Shaibu and Iroegbu (2003) carried out a study entitled: **A Study of the**

Relationship Between Parents' and Teachers' Motivational Support and Secondary School Students' Achievement in Science. The study investigated the interaction, if any between parents' motivational support for their children/wards and the academic achievement of the latter. It also investigated the relationship, if any between science teachers' motivational support for their students and the academic achievement of such students in science. Two related null hypotheses were stated and tested.

A total of 360 senior secondary school III science students, obtained through simple random sampling comprised the subjects of the study. They comprised 210 boys and 150 girls drawn from three educational zones, namely, Abia, Afikpo and Umuhia educational zones in Abia State. Their average chronological age was 17 years. Two structured likert – type questionnaire constituted the instruments used for data collection. The reliability coefficient of the instruments, obtained through split-half method and adjusted by the Spearman – Brown prophecy formula were 0.75 and 0.78 respectively. The questionnaire were administered by the researchers to the subjects in their respective schools via face-to-face contact for all the three basic science subjects, Biology, Chemistry and Physics.

Results

The results from the study are shown in Tables 4.6(a) and 4.6.(b).

Table 4.6.(a) Correlation Between Parents' Motivational Support and Students' (their children) Academic Achievement in Science

S/N	Subject	N	r	r^2	r (critical)	df	P
1.	Biology	350	0.42	0.18	0.12	348	0.022
2.	Chemistry	350	0.44	0.19	0.12	348	0.024
3.	Physics	350	0.40	0.16	0.10	348	0.020

Table 4.6(b) Correlation Between Teachers Motivational Support and their Students' Academic Achievement in Science

S/N	Subject	N	r	r^2	r (critical)	df	P
1.	Biology	350	0.45	0.20	0.12	348	0.024
2.	Chemistry	350	0.46	0.21	0.14	348	0.024
3.	Physics	350	0.48	0.23	0.15	348	0.026

r is +vely correlated and significant at $P \leq 0.05$

Findings

The results show that:

(i) there is positive and significant correlation between parents' motivational support for their children/wards and the academic achievement of the latter in science.

(ii) there is positive and significant correlation between teachers' motivational support for their students and the academic achievement of the students.

(iii)the coefficient of determination (r^2) indicates that the variance in academic achievement accounted for by parents' motivational support ranges between 16% - 18% while those for teachers motivational support ranges from 20% - 23% in the three subjects under study.

Implications for Teaching and Learning of Science

(i) Students' academic achievement in science is influenced not only by factors prevalent in the school but also by the social and cultural home factors.

(ii) Science teachers should be sentive and receptive to socio-cultural backgrounds of their students and blend same to the process of teaching and learning as a way forward to improve academic achievement of their students in science.

4.2.4 Curriculum – Related Factors

Curriculum, both as a terminology and as a concept especially, is most often misunderstood and also misconstrued even by those within the education industry. It has been defined variously by many authors and scholars. A few example here will suffice. Onwuka (1981) defined curriculum as the process of determining and pursuing set social objectives through the instrumentality of the school. Tanner and Tanner (1985) defined it as the planned and guided learning experiences and intended outcomes formulated through the systemic and systematic construction of knowledge under the auspices of the school for learners continous and meaningful growth in personal, social and vocational competencies. Ben-Yunusa (2002) opined that curriculum is both the essence and product of the distilled thinking of the society.

Shaibu (2014) observed that the science curriculum in Nigerian schools are deficient philosophically and thus handicapped

in helping to point the way forward for learners academic achievement and hence for national development. It was within this contextual background that Shaibu and Bichi (2003) investigated the efficacy of two models of curriculum packages with respect to their potency in promoting students' academic achievement in science. The study is entitled **Effect of Historically – Enriched Curriculum on Science Students' Academic Achievement in Evolution Concepts in Nigerian Secondary School.** It focused on the concept of evolution as one typical example of the science concepts that students often find difficult to understand and thus achieve poorly. The aim was to compare the relative effectiveness of the conventional biology curriculum with the historically – enriched one and to find out which of them would help to promote students' academic achievement in biology. Scholars, for example, Anderson, (1990) and Jensen and Finley (1995) reported the relative efficacy of an historically – enriched curriculum, and showed that it was moderately effective in enhancing students' academic achievement in the area of Darwinian evolution concepts. Furthermore, Jensen and Finley (1996) postulated that the instructional use of historically – enriched curriculum is based on the premise that its use meets the pedagogic requirements for conceptual change among science students and consequently enhanced their understanding and thus promoting academic achievement.

The focus of the study was to find out if historically – enriched curriculum would prove superior or otherwise over the conventional biology curriculum that have been generally in use. The population comprised SSS 3 biology students from Giwa Education Zone. A total of 104 of the students were obtained by simple random selection from the total 868 students. The quasi-experimental design involving the matched group, pre-posttest approach was used. The experimental and control groups, comprised 52 subjects each. The experimental group (EG) comprising 30 male and 22 female students, was treated with the historically – enriched curriculum while the control group (CG) comprising 34 males and 18 females students, was taught using the conventional curriculum. The treatment lasted six weeks of 2 hours instruction each day of the working week. Both groups were posttested at the end of the treatment period, using the Evolution Concept Test (ECT) as the main instrument ($r = 0.72$). Data collected was computer analyzed using the SPSS software.

The Results

The results obtained are presented in Tables 4.7(a) and 4.7(b).

Table 4.7(a) t-Test Analysis of the Pretest Mean Scores of the Experimental and Control Groups

Groups	N	$\bar{X}$	SD	t-value	df	P
EG	52	12.16	3.55	0.07*	102	0.49
CG	52	11.72	3.04			

t – not significant at $p \leq 0.05$

Table 4.7(b). t-Test Analysis of the Posttest Mean Scores of the Experimental and Control Groups

Groups	N	$\bar{X}$	SD	t-value	df	P
EG	52	18.55	6.70	3.22*	102	0.01
CG	52	14.16	4.76			

* **Significant** at $P \leq 0.05$

Findings

The following constitute some of the major findings from the study:

1. The subjects in the experimental group i.e. the group that was exposed to the historically– enriched curriculum achieved significantly higher than their counterpart in the control group.
2. The historical links and additives blended into the historically – enriched curriculum tended to humanize science teaching and helped the subjects exposed to it (EG) to achieve higher.
3. The humanization flavour blended into the historically – enriched curriculum tended to have positively affected conceptual and behavioural disposition of the subjects exposed to it (EG) in a manner that they saw the science concepts taught more as human ideas and human enterprise which can be meaningfully and successfully engaged in by human beings like them.

4. The blending of relevant science history into the curriculum tended to have minimized, if not totally remove the usual mystification and sacrosanct perception of science by science students, thus enhancing positive engagement that consequently resulted in improved academic achievement.

Pedagogic Implications

1. The humanistic model of science education, which conceives of, and presents science as a human activity constructed by human mind, and engaged in by human kind paves a way forward for effective instructional strategies in science and consequently improved academic achievement by the students exposed to such mode of instruction.
2. The hypothetico – deductive paradigm of science which places emphasis on the role of subjective conjectures as a basis for deriving testable scientific hypotheses has its foundation in the humanistic paradigm of science and is viable for enhancing academic achievement of students in science.
3. The constructivist model of science educational practice which stipulates that knowledge is not transferred from one head to another, but rather that individuals actively make meaning of external stimuli and thus construct their own knowledge is equally founded on the humanistic principles of science teaching and learning. Science teachers at all educational levels need to be acquainted with these and explore them to maximally enhance the academic achievements of their students.

4.2.5 Instructional Strategy – Related Factors

It has been reported in literature that the manner in which science subjects are taught in schools requires the majority of science teachers to use the traditional, talk – and – chalk method of teaching (Shaibu and Mari, 2003, Usman, 2000). The findings from these studies showed, for example that most science teachers do not encourage students' active participation in the teaching/learning process. Lack of such active participation of students has been identified as one of the major factors responsible for poor academic achievement of students in science subjects. This was found to have

reflected in students' low academic achievement in the Senior School Certificate Examinations (SSCE) year after year. It is within the context of this that an investigation was carried out by Shaibu and Usman (2002) to identify possible instructional strategy that might be helpful in the search for students' improved academic achievement in science. It was entitled:

The Effects of NISTEP Mode of Teaching on Junior Secondary School Students' Academic Achievement in Integrated Science

NISTEP is an acronym which stands for Nigerian Integrated Science Teacher – Education Project. Its teaching approach derives from the psychological principle that students learn better through active participation in the teaching learning process that might often involve exposure to activity – based methods (Kempa, 1986). Goals of integrated science teaching is to develop in the learners the following skills:

(i) Active involvement in the teaching/learning process
(ii) Ability to learn with some degree of independent mind
(iii) Recall of information for use in relevant contexts
(iv) Devising of cognitive schemes for solving problems
(v) Classifying and using information flexibly
(vi) Interpreting data appropriately
(vii) Communicating results/findings effectively.

The population of the study comprised fifteen junior secondary schools located within Sabon Gari Local Government Area of Kaduna State. A total of two co-educational schools were purposively selected from the population and 100 students were randomly selected from the two schools i.e. 50 students from each school. Through the process of simple random selection one of the schools was used as the experimental group while the other was used as the control. Two topics – feeding in plants and energy conversion were used for treatment which lasted six weeks. The experimental and control groups were matched before the experiment. The instrument used for data collection was the Integrated Science Achievement Test (ISAT) which was adapted from Iyang (1988). The reliability coefficient was re-calculated and found to be 0.86. The NISTEP method of teaching (Appendix I)

was used as instructional strategy for the experimental group (EG) while the traditional lecture method was used in the control group (CG) to teach the same topics as the experimental group. At the end of six weeks of treatment a posttest was administered to both groups. The data collected was computer – analyzed using the SPSS software.

Results

The results obtained from the study are shown in Tables 4.8(a) and 4.8(b).

Table 4.8(a). Comparison of the Pretest Mean Scores of the Experimental and Control Groups

Groups	N	$\bar{X}$	SD	t-value	df	P
EG	50	8.20	3.50	1.20	98	0.42
CG	50	6.02	3.10			

Not significant at $P \leq 0.05$

Table 4.8(b). Comparison of the Posttest Mean Scores of the Experimental and Control Groups

Groups	N	$\bar{X}$	SD	t-value	P
EG	50	15.01	3.90	11.78*	0.01
CG	50	7.85	4.02		

* Significant at $P \leq 0.05$

Findings

The following comprise the major findings from the study:

(i) The difference in the pretest mean scores of the subjects in the experimental and control groups was not significant statistically, meaning they were academically equivalent before the treatment intervention.

(ii) The academic achievement of the subjects in the experimental group was statistically superior to their counterparts in the control group. This can only be attributable to the use of the NITEP method of teaching which seemed to have proved more effective than the traditional lecture method used for the control group.

(iii) Exposure of science students to learner – centered and activity – based instructional strategies have viable potentials for improving the academic achievement of students in science.

Implications for Pedagogy

(i) The basic professional skills and expertise for engaging in the use of learner – centered instructional approach should begin to receive adequate attention.

(ii) The re-appraisal of science curriculum and pedagogic skills for effective activity – based instructional approach should receive the needed emphasis at all levels of education.

5.0 Discernible Road Maps from Science Education Research Studies

The following comprise some of the major signposts that have been identified from this lecture and which constitute potential and veritable road maps to help navigate us out of the maze of students' underachievement in science.

a. Science Teachers' Professional Skills

Teachers' professional skills to operate at the same or at least, similar conceptual levels with their students in the business of teaching and learning science in order to reduce students' conceptual bottlenecks is vital (study on Topic difficulties: 4.2.1(a))

b. Science Teachers' Expertise to perform conceptual task-analysis

Teachers' expertise to perform conceptual task-analysis of the subject matter they teach logically in order to guide teaching sequence from the known to the unknown is needed more than ever before to promote meaningful leaning (Students' Achievement in Savoy's concepts: 4.2.1(b))

c. Existence of gap between science students' conceptual and strategic knowledge

The existence of a wide gap between science students' conceptual knowledge and their problem solving proficiency calls for urgent attention of science teachers and curriculum planners in order to minimize significantly students' academic underachievement in science (Relationship

between conceptual knowledge and problem-solving proficiency... 4.2.1 (c))

d. Remediation of Difficult Concepts

Science students' conceptual difficulties that often manifest as observable under-achievement can be remediated by the teacher to a tolerable level if appropriate psycho-social, professional, pedagogic expertise and teacher motivation are in place. (Structured text approach to remediating difficult concepts 4.2.1 (d))

e. Gender-related Differences

Gender-related differences, e.g societal expectations, cultural values and sex role stereotyping often have negative effects on science students' academic achievement (Gender-related differences... 4.2.2)

f. Parents' and Teachers' Motivational Support

Parents' and also teachers' motivational support for their children and their students respectively are direct functions of students' academic achievement in science (Parental and Teachers' motivational support: 4.2.3)

g. Philosophical and Psychological Orientation of Curriculum Materials

The philosophical and psychological assumptions that guide the design of science curriculum materials can either promote or hinder students' academic achievements in science (Effects of historically-enriched curriculum... 4.2.4)

h. Effectiveness of Teacher – Training Programmes

The kind and effectiveness of teacher-training programmes designed and implemented at all levels of education have direct influence on science students' academic achievement.

i. Instructional Models used by Science Teachers

The cooperative and humanistic models of science teaching and learning have laudable potentials for improving students' academic achievement in science.

6.0 Conclusion and Recommendations

6.1 Conclusions

a. Students' underachievement in science cannot be accounted for by a simple or single factor, but a multiplicity of complex interrelated factors.

b. Some of the categories of factors that militate against students' academic achievement in science include the following:

Teacher factors
Students factors
Societal factors
Curriculum-related factors
Cultural and belief factors
Gender-related factors
Political, Economic and national value system factors

c. The teaching and learning of science as a set of dogmas rather than a set of human activities designed by human mind to explore natural phenomena has negative effects on students' academic achievement in science.

d. The tacit societal endorsement of greed, graft and avarice that have bred and sustained debilitating corruption, thereby focusing our attention on materialism and diverting same away from hardwork and commensurate investment on education by private individuals, organizations and more importantly various tiers of government is a major source and cause of students' patent underachievement in science.

6.2 Recommendations

a. The teaching and learning of science should put greater premium on the humanistic model of instruction as this has potential for promoting students' academic achievement.

b. The national policy statement underlying the philosophical objectives of our educational system at all levels needs to be revised and refined to make it more pragmatic in a manner

that is both practically implementable and empirically amenable for evaluation.

c. There is a great and urgent need to improve on the quality, effectiveness and flexibility of our teacher training systems at all educational levels thereby enhancing the professional skills and expertise of science teachers who are the key players in the search for improving students' underachievement in science.

d. The situation in which teachers at all educational levels are constrained to "fight" for their professional rights and conducive working conditions, using available and legitimate labour tools is extremely inimical to teachers' motivation and ultimately students' academic achievement in science. The Federal Government and other tiers of Government should as a matter of priority take necessary steps to provide the appropriate recognition, respect, conducive psycho-social atmosphere and patently commensurate and enhanced service conditions and reward mechanisms for teachers at all educational levels to stem the tide of students' underachievement in science

e. The hypothetico-deductive paradigm of science teaching and learning which also derive from humanistic principles should be given greater emphasis especially in its application for cooperative learning of science as opposed to competitive learning strategy.

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Appendix

NISTEP MODE OF INSTRUCTIONAL STRATEGY

The NISTEP mode of teaching involves the following procedure/process:

I. Division of students into small groups of 5 - 8 per group.
II. Brain storming session where students were asked some questions or given assignment on a topic to work on by the teacher. To answer the questions asked, the students were asked to carry out activities on the students' activity sheets provided (which lasted for 20 minutes).
III. Presentation of group answers for the whole class discussion (which lasted for 20 minutes).
IV Moderation of group presentation by the teacher and coming up with correct answer (lasted for 10 minutes).
V Writing final report by the students (lasted for 10 minutes).

The flow-chart for the use of NISTEP mode of teaching is as follows:

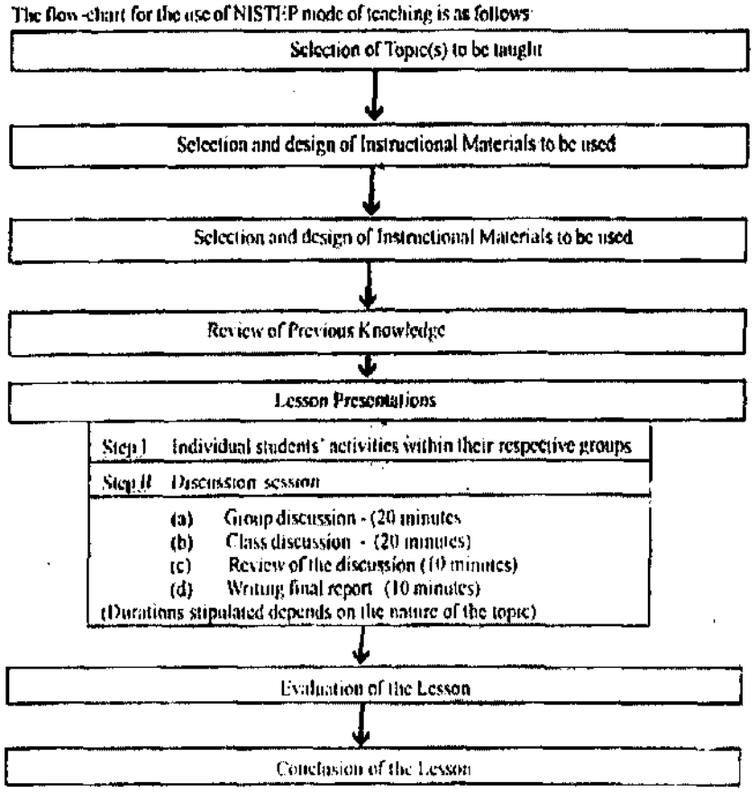


Fig. 1.
Flow chart of the NISTEP Mode of Teaching Integrated Science
Source: Turton, P. (1993) NISTEP Integrated Science Resource Materials

Chapter Nine

The Challenge of Diabetes Mellitus:
The Urgent Need for Life style Modification

The Challenge of Diabetes Mellitus:

The Urgent Need for Life style Modification

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Prologue

> *"No human ever filled a container more evil than his belly. The few morsels needed to support his being shall suffice the son of Adam. But if there is no recourse then one third for his food, one third for his drink and one third for his breath." (Muhammad Rasulullah SA.W. as reported by Ahmad and At-Tirmidhi).*

> *The person who passes urine which is exceedingly sweet, cool, slightly viscid, turbid, and resembling the juices of the sugarcane . . . suffers from glycosuria....There are two types of urinary disorders—one, natural due to genetic factors, and the other due to indiscreet living or dietetic indiscretions. The patient suffering from the former is thin, pale, eats less and drinks too much.... The patient with the latter is usually obese, eats a lot, is stout, of sedentary habits and sleeps too much. (Charaka Samhita and Sushnita Ayurveda, 100-200BC).*

It is indeed a great honor to stand before you this afternoon to deliver this inaugural lecture on behalf of the Department of Medicine. This would be the third inaugural lecture from the Department after the ones delivered by my great teacher and mentor Professor Geoffrey C. Onyemelukwe in 1997 and more recently my brother, friend and current Head of Department; Professor Balarabe Sani Garko in February 2014.

The Vice-Chancellor Sir, distinguished ladies and gentlemen, the title of my lecture today seems too obvious to even the most ordinary of minds. I had thought of many other titles such as "the bitter side of Sugar", "the price of over indulgence" "starvation in the midst of plenty", and "Moderation; the Key to Life" for this lecture, but settled on "The Challenge of Diabetes Mellitus: An Urgent Need for Life Style Modification." As diabetes

is a household name today in our community affecting the rich and poor alike.

As a Physician, my training has been and would continue to be the application of scientific knowledge to appreciate and maintain balance between extremes. This critical balance between extremes is what is regarded as "normal" in the general parlance. Hence we talk of a normal height (not too tall and not too short), normal weight (not fat or lean), a normal blood pressure (not low or high), normal blood sugar (not low or high) etc. It therefore follows that for all attributes, activities, functions there is what is considered normal or abnormal variation.

The Vice-Chancellor Sir, I intend to take us through a malady that is threatening mankind with extinction if urgent measures are not taken to control it. This malady results from the breakdown of glucose regulation which to a large extent has been occasioned by our failure to moderate our lives. I would be sharing our experiences on the challenge posed by diabetes mellitus.

Introduction

Diabetes mellitus a multifaceted, heterogeneous and a multifactorial metabolic disorder is characterized by chronic hyperglycaemia.[1-7] The term diabetes mellitus is derived from two Greek words *diabetes* meaning siphon (i.e. that which passes through) in Greek; and *mellitus, which* is a Greek word for sweet. *Mellitus* also means honey in Latin. The term diabetes was first used in the second century to describe the condition based on the two most common symptoms i.e. excessive thirst and excessive urination[5]. The urine of these patients tastes sweet and hence the addition of the adjective *mellitus*.

Diabetes mellitus is not a single disease, but several disease conditions that manifest with hyperglycaemia (the hallmark of diabetes mellitus) as the final common factor. [1,8,9] Chronic (prolonged) hyperglycaemia results from several and diverse disease processes, which leads to either total; or relative deficiency of insulin (a hormone secreted from the pancreas that helps body cells to utilize glucose). The deficient action of insulin is associated with disturbances in the ability of the body to utilize the major food classes utilized by the body namely: carbohydrate, fat and protein. It arises when the pancreas fails to produce enough insulin (type I

diabetes), or when the body cannot promptly secrete and or effectively make use of the insulin produced (type 2 diabetes).

There is evidence that there were descriptions of diabetes in Egypt as early as the 15th century BC[4]. Similarly, Avicenna the famous 11th century Arab clinician, has to his credit detailed descriptions of diabetes mellitus in medical literature. Although diabetes existed for quite a long time, it was however quite rare then. It has been stated that Galen saw only two cases of diabetes in his entire medical career[5]. Similarly, the existence of the disorder in Africa was extremely rare[10].

Although diabetes mellitus has been in existence from time immemorial, the incidence (number of new cases occurring in a given population per-year) and prevalence (proportion of a given population with the condition at a particular point in time) have exponentially increased, and continues to rise in a global scale. In other words, it is now a pandemic. Its prevalence estimated at 150 million people in 2001 increased to 382million in 2013, and is expected to exceed 471million by the year 2035. [6,7] This is due to a mixture of factors such as progressive increase in population size, increased proportion of older adults in the population and most importantly unhealthy lifestyles. The prediabetic state of impaired glucose tolerance and impaired fasting glucose are even more prevalent than diabetes itself, meaning that the future is even more bleak, if urgent steps are not taken to reverse this ugly trend.

Quite unfortunately, and most importantly for us; the rapid increase in the incidence and prevalence of diabetes mellitus has been more dramatic in developing countries; places that could least afford the cost implications of these changes both in terms of human and material resources. Fortunately however, preventive measures are practicable and have been shown to be the most cost-effective method in the control of this menace that threatens the very existence of mankind.[10, 11]. This however requires appropriate knowledge by all and sundry, but more especially policy makers, diabetic individuals and their relatives; and indeed all health workers.

Normal Carbohydrate Metabolism

To properly appreciate diabetes mellitus, there is the need to appreciate the processes that normally take place in the day-to-day

routine of eating and fasting. It is well appreciated that we are not always eating, but eat a specified number of meals every day; in between which the energy requirements for the normal day-to-day activities are supplied from our storage pools.

In other words, there are feast periods interspersed with periods of fasting. The excess energy consumed during the feast period is stored to be utilized during the fasting period.

There are basically three main classes of macronutrients; namely carbohydrates, proteins and fats. These are however too complex to be absorbed by the intestinal lining (***mucosa***). After the process of digestion (a complex process that involves both enzymes and mechanical factors) however, carbohydrates are broken down to simpler sugars mainly glucose. Proteins are broken down to amino acids and fats are broken down to fatty acids and glycerol. These simpler compounds are easily absorbed by the intestinal mucosa and through the blood circulation (***portal circulation***) reaches the pancreas, the liver and the general (***systemic***) circulation.

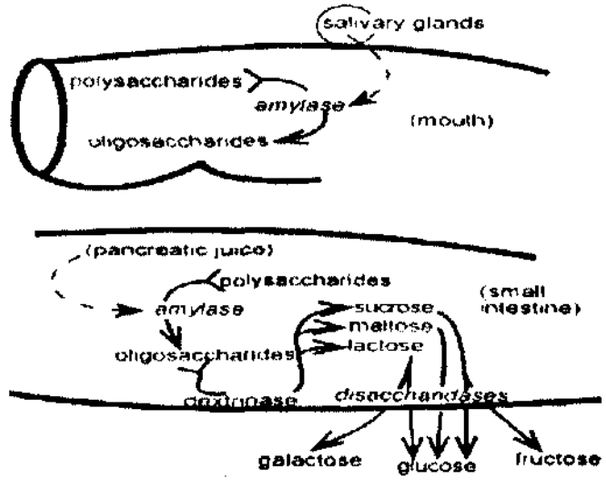


Figure 1: Digestion of Carbohydrates.

Following a meal, glucose derived from food appears in the systemic circulation within as early as 5 to 10 minutes. [13,14] In the pancreas, the resultant increase in portal plasma glucose and amino acids stimulates the secretion of ***insulin*** and suppresses the secretion

of ***glucagon*** (a hormone in the pancreas that does the exact opposite of insulin). The resultant rise of plasma insulin level in the portal circulation leads to several events. These events are sometimes referred to as ***anabolic*** (body building) actions of insulin. These anabolic actions of insulin are:

i. Conversion of glucose to glycogen which is then stored in the liver and skeletal muscle for use when nutrients are deficient.(as much as 40% of glucose derived from food is eventually taken up by the liver)
ii. Blockage of liver output of glucose (prevention of glycogenolysis), hepatic glucose production is suppressed by as much as 60 %.
iii. Storage of fatty acids and glycerol in fat cells and inhibition of breakdown of fat (prevents lipolysis).
iv. Prevention of break down of muscles and stimulation of storage of amino acids as proteins in skeletal muscles.

When blood glucose levels decline, pancreatic secretion of insulin follows suit, on the other hand; pancreatic secretion of ***glucagon*** rises. The sole function of glucagon is to do the exact opposite of what insulin does, i.e. to increase blood glucse levels and avoid hypoglycaemia (low blood glucose levels) this it does by stimulating the liver to produce glucose by breaking glycogen (glycogenolysis). However,when fasting exceeds 12-15 hours, depletion of hepatic glycogen stores occurs resulting in increase in the rate of gluconeogenesis (production of glucose from other sources usually protein) to make up for tissue demands. These processes are aimed at maintaining a tight control on blood sugar such that it is neither high nor low and maintain glucose levels within the normal range in normal individuals. This is important, as glucose is the single most important fuel in the body with out which the brain cannot function for more than 5 minutes. It is also noteworthy that other hormones such as adrenalin, thyroid hormones, corticosteroids, and growth hormone all exhibit effects similar to that of glucagon on glucose homeostasis and are actually brought to action under situations of biological stress.

Insummary,starches are digested in the gut from where they enter the blood stream in the form of glucose. Figure 2 below

summarises the respective roles of insulin and glucagon in glucose homeostasis.

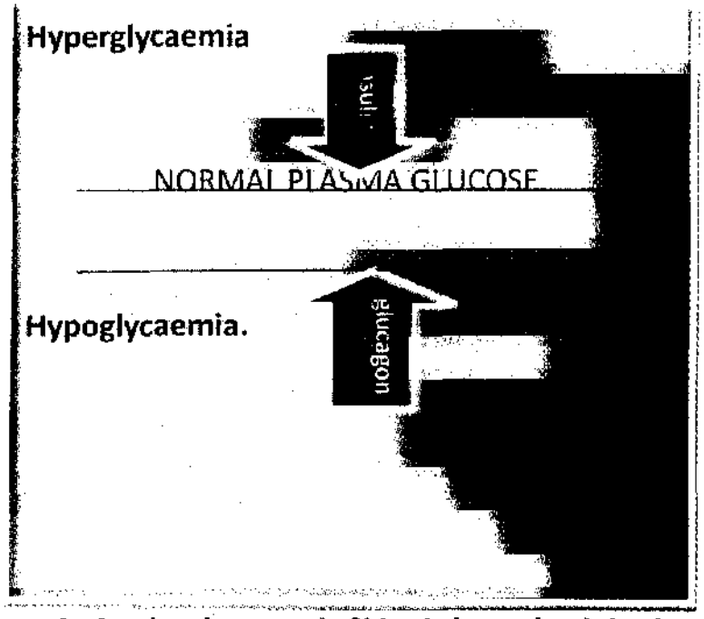


Figure 2: showing the control of blood glucose levels by the main hormones of glucose control

The glucose in the blood stream becomes a potential source of energy for the entire body, similar to the way in which petrol is a potential source of energy for your car. Similarly, just as the petrol in the tank of the car needs to be pumped into the car engine to be of any effect, the body requires some assistance to get glucose from the blood stream to the muscles and other tissues of the body. In the body, that assistance comes from a hormone called insulin. Without insulin, glucose cannot get into the cells to be used as fuel. Instead, it accumulates in the blood to high levels and is excreted or "spilled" into the urine through the kidneys once the renal threshold (usually 10mmol/L) is exceeded.

Glucose Intolerance

When blood glucose levels are persistently elevated above normal, glucose intolerance is said to be present, diabetes mellitus

being the worst form of it. Although the pathogenesis of type 2 diabetes is not fully understood, there appears to be a transitory intermediate state between normoglycemia and type 2 diabetes. The World Health Organization (WHO) in 1999 recognized the presence of two transitory intermediate states as separate classes of glucose intolerance. These intermediate states are; impaired fasting glycaemia (IFG), and impaired glucose tolerance (IGT). These states (IGT and IFG) are termed prediabetes. According to International Diabetes Federation (IDF)/WHO criteria, IFG is defined as fasting plasma glucose (FPG) of 6.1 to 6.9 mmol/l while the American Diabetes Association (ADA) criteria define it as a FPG of 5.6 to 6.9 mmol/l. On the other hand, IGT is defined as plasma glucose concentration of 7.8 to 11.0 mmol/l after a two-hour 75g (anhydrous) oral glucose load, referred to as Oral Glucose Tolerance Test (OGTT).[15]

Impaired fasting glycaemia (IFG)

When fasting plasma glucose levels are above 6.0mmol/L (110mg/dl) but less than 7.0mmol/L (126mg/dl) the cut off point for the diagnosis of diabetes, impaired fasting glycaemia is said to be present. It is important to investigate such individuals further by requesting post-prandial blood glucose (preferably a 2-hour post prandial blood sugar); if the values are indeterminate, an OGTT may be prudent to properly classify the type of glucose intolerance.

Impaired Glucose Tolerance (IGT)

IGT is diagnosed when a 2 hour plasma glucose after an OGTTT is $\geq$ 7.8 mmol/l (140mg/dl) but less than 11.1mmol/l (200mg/dl) the cut off point for the diagnosis of diabetes. Although not all individuals with IGT develop diabetes, approximately one in three individuals with IGT will develop type 2 diabetes within 10 years if left untreated, suggesting that they are at increased risk and therefore a potential intervention target group. Although IGT itself is not diabetes, it however carries a significant risk of large vessel disease such as strokes, heart attacks and peripheral vascular disease.

Classification of Diabetes Mellitus

The current classification of mellitus is summarized below[1].

- ❖ Type 1 (1a, 1b)
- ❖ Type 2 Diabetes.
- ❖ Gestational Diabetes.
- ❖ Secondary Diabetes.

Type 1 Diabetes

Type 1 Diabetic patients have little or no endogenous insulin secretory capacity, and therefore require insulin therapy for survival. There are two main forms of clinical type 1 diabetes designated types 1a and b.

Type 1a

This form of type-1 diabetes results from immunologic destruction of pancreatic ß cells as a result of auto-immunity. The susceptibility and trigger factors are not clear but both genetic and environmental factors play significant role. Type 1a is characterized by the presence of islet cell antibodies (ICA), anti-glutamic acid decarboxylate (anti-GAD), IA-2 or insulin antibodies that helps to point at the autoimmune process. The rate of pancreatic ß cell damage varies from one individual to another; when 80% to 90% of pancreatic ß have been destroyed clinical diabetes develops as a result of insulin deficiency. However, it is also possible to have features of diabetes in the event of stressful conditions such as acute infections even when the beta-cell reserve is much higher than this. In these circumstances, normoglycaemia may resume after the acute stress have abated only to reappear when the critical level of destruction of the beta cell has occurred. This is the so called honey moon period, and such patients should not be confused with type-2 diabetic patients.

About 90% of type 1 cases in Europe manifest type1a diabetes and show evidence of auto-antibodies in their sera. In Africa however, the proportion of type-1 in this category is likely to be less than what has been observed in Europe as autoimmune disorders are generally less prevalent probably as a result of the interactions between the immune system and several infections and infestations like malaria.

Type 1b

In type 1b on the other hand, there is no evidence of autoimmunity and hence called idiopathic and constitute about 10% of type 1 diabetes in Europe. To date, there is no known etiological basis for type 1b diabetes mellitus. Some of these patients have permanent insulinopaenia and are prone to ketoacidosis, but have no evidence of autoimmunity. This form is more prevalent among individuals of African and Asian origin and may indeed be some form of type-2 diabetes or poorly characterised secondary diabetes from primary beta-cell failure[1].

Type 2 diabetes

Type 2 diabetes is the commonest form of diabetes and is characterized by disorders of insulin secretion and insulin resistance. Globally, it affects about 5-7% of the world's population. This prevalence is underestimated because many cases, perhaps 50% in some population, remain undiagnosed[7].

Gestational Diabetes mellitus

Gestational Diabetes mellitus (GDM) refers to the onset or initial recognition of glucose intolerance during pregnancy, usually in the second or third trimester. A clear distinction should be made between this class and a pregnant diabetic patient, this would however be possible after the peuperium.

Secondary diabetes

Secondary diabetes is said to be present when an identifiable cause has been established as the cause of diabetes. The causes of secondary diabetes include genetic defects of the pancreatic ß cell or genetic defects in the pathways of insulin action such as insulin receptor mutations or post-receptor defects. Also included are diseases of the exocrine pancreas such as pancreatitis and disorders of endocrine glands producing excessive insulin counter regulatory hormones such disorders include thyrotoxicosis, Cushing's syndrome, acromegaly, phaeochromocytoma etc. Also known to cause secondary diabetes are certain drugs such glucocorticoids, pentamidine, reverse transcriptase inhibitors, and α-interferon. We have reported the first case of diabetes mellitus resulting from anti-retroviral therapy in West Africa.[9]

The Epidemic of type-2 Diabetes

There has been progressive increases in the incidence and prevalence of type 2 diabetes worldwide, this is particularly so in underdeveloped, and developing countries. . Its prevalence estimated at 150 million people in 2001 increased to 382million in 2013 is expected to exceed 471million by the year 2035. [6, 7] In 2013, 5.1 million people died of diabetes meaning 10 people died every minute from diabetes in 2013. Equally worrisome is the fact that the epidemic affects mainly those aged between 40-59 years of age especially in the developing countries implying that the productive members of the society are lost with resultant negative effects on the economies of these countries. Diabetes indeed led to at least 548 billion United States Dollars in direct health care costs (about 11% of total health care spending on adults)[7]. More worrisome is the fact that 80% of diabetics live in low and middle income countries. Place of residence is a major determinant of DM in sub-Saharan Africa with urban residents having higher prevalence of DM than their rural counterparts. In low and middle income countries, the number of people with DM in urban areas is 172 million, while 119 million live in rural areas. By 2030 the difference is expected to widen with 314 million people living in urban areas and 143 million in rural areas[7].This is attributable to lifestyle changes associated with urbanization. Changes in lifestyles such as excessive intake of calories (usually refined foods), decreased physical activity leading to sedentary lifestyles as a result of modernization as well as genetic factors are responsible for this change.

The Role of Genes

Familial clustering and high concordance rates among monozygotic (identical) and dizygotic (non-identical) twins argue strongly for a role of genetic factors in the aetiology of type 2 diabetes [16,17] . In a prospective study of 2,322 Swedish men, 1,860 of whom turned up for follow-up 7 to 14 years later, the incidence of diabetes rose from 3% among those who had no close relative with diabetes to 16% among those with two or more diabetic relatives (more than fivefold increase). [16] Furthermore, the prevalence of diabetes among parents or siblings was found to be at least twice among those who developed diabetes when compared to those who did not develop diabetes. Despite these suggestions of a probable

role of genetic factors in the causation of type 2 diabetes, the actual gene or genes that are important in the causation of type 2 diabetes mellitus however remains elusive. It is most probable that the genes that are inherited increases tendency to the development of tye-2 diabetes when other environmental factors are favorable, in other words, they play a permissive role in the causation of type-2 diabetes.

The Role of Modifiable Environmental Factors

Environmental factors provide the necessary conditions for the development of type 2 diabetes mellitus given the right genetic environment. Established acquired risk factors for the development of type 2 diabetes include ***obesity*** ***increasing age***, ***physical inactivity***, and ***urbanization*** [19-22].

Obesity

Excessive weight is probably the most important modifiable acquired risk factor in the aetiology of type 2 diabetes found in many cross sectional and longitudinal studies. It has been stated that 50% of the diabetic epidemic in the developing world could be reversed simply by controlling the scourge of weight gain in these communities[17]. To define the degree of obesity, the body mass index (BMI) is calculated by dividing body weight (in kilograms) by the square of the height (in meters) [18]. Based on BMI, individuals may be classified as follows:

- Underweight = BMI < 18.5
- Normal weight. = BMI 18.5 -24.99
- Preobese = BMI 25.0-29.99
- Obese class I = BMI 30.0 – 34.99
- Obese class II = BMI 35.0 – 39.99
- Obese class III = BMI > 40.0

In a prospective study involving a cohort of healthy Swedish men, followed up for the development of type 2 diabetes mellitus, the incidence of diabetes mellitus rose by a factor of twenty-two when individuals with the highest BMI were compared with those who had the lowest BMI[15]. Similarly, a prospective study involving more than 7000 British men (mean follow-up of 12.8 years) established a strong positive correlation between a high BMI and the

development of type 2 diabetes. [17] These observations are expected as obesity is known to induce insulin resistance

Aging

Although not modifiable, increasing age is known to be associated with insulin resistance[19]. This implies that with increasing age, "risky lifestyles" are more likely to result in the development of diabetes mellitus.

Sedentary life styles

Sedentary life have been shown to be a significant risk factor for the development of type 2 diabetes and regular moderate exercise reduces the risk of type 2 diabetes by improving insulin sensitivity[20,21]. More than 50% reduction in the risk of development of type 2 diabetes has been reported by moderately vigorous exercise in the British study referred to above.

Role of Urbanization

Urbanization has been shown to significantly increase the risk of development of type-2 diabetes[22]. This could be due to life-style changes such as increased caloric intake usually in the form of junk foods containing dense calories, increase use of machinery and therefore less tendencies to physical exertion with consequent weight gain could partially explain this trend. In Africa, Urban lifestyle is characterized by changes in dietary habits involving an increase in the consumption of refined sugars, saturated fat, and reduction in fiber intake. Urbanization tends to decrease physical activity as very little physical activity is required for daily living whereas rural populations rely on foot walk as transportation means and often have intense agricultural activities as their main occupation. Furthermore psychosocial stress associated with urbanization may also contribute to this increased risk. It is interesting to note that more recently; the stress attributable to shift work has been shown to be positively associated with the risk of developing type-2 diabetes[23].

Role of intra-uterine and early childhood events

There are suggestions that in the hunter-gatherer life-style of our predecessors genes were acquired to enable the storage of

energy in the form of fat in adipose tissue[24]. By encouraging the storage of energy, energy supply during periods of food shortage is guaranteed. This was a definite advantage to ensure survival. In the setting of affluence however, these genes continue to promote energy storage, which results in obesity which in turn induces insulin resistance and glucose intolerance. This is referred to as the thrifty genotype hypothesis. In support of this hypothesis, are observations among Pima Indians of Arizona, USA. In that population, dramatic changes in life-styles from the traditional form, characterized by low caloric intake as well as demands of more strenuous physical activity to a more sedentary form associated with excessive consumption of calories resulted into high rates of obesity, glucose intolerance and type 2 diabetes mellitus. Conversely, a sister tribe of the Pima Indians residing in northern Mexico still maintains the traditional life-styles and has lower rates of obesity and type 2 diabetes[21].

An alternative "thrifty phenotype" hypothesis on the other hand, suggests that environmental constraint on fetal growth such as intra-uterine malnutrition results in adaptive changes in the development of some organs in the feotus[25]. This is aimed at preserving the growth of certain organs considered essential to survival of the fetus. Such organs include the brain at the expense of others such as the viscera. The resultant changes lead to under development of the endocrine pancreas and the liver, leading to reduced capacity for insulin secretion and insulin resistance respectively. This leads to increased susceptibility to type 2 diabetes in adult life. This hypothesis is supported by epidemiological observations that consistently demonstrated associations between indices of poor fetal and infant growth with susceptibility to glucose intolerance in adult life. In a follow up study of 468 British men born between 1920-1930 whose birth weights were known, Hales and coworkers found that plasma glucose levels at 30 minutes and two-hours during OGTT were inversely proportional to birth weights[26]. Furthermore, the rate of impaired glucose tolerance increased with lower body weight at one year (26% among those weighing 8.16 Kg or less at the age of one year versus 13% among those weighing 12.25 Kg or more at one year of age).

Similarly, the Nurses' Health Study[27], involving a cohort of 121,701 United States women born between 1921 and 1946

concluded that birth weight is inversely associated with risk of development of type 2 diabetes mellitus.

Pathogenesis of type-2 Diabetes

Type-2 diabetes mellitus is a heterogeneous metabolic disorder characterized by chronic hyperglycaemia due to dynamic interactions between varying defects of insulin secretion and insulin resistance. Insulin resistance refers to the inadequate response of the skeletal muscle, liver, and adipose tissue to the endogenous insulin secretions. In addition to insulin resistance, β-cell dysfunction plays an integral role in the pathogenesis of T2DM. In healthy individuals, β-cells can reverse insulin resistance by increasing the production and secretion of insulin. Glucose sensors located on β-cells sense the rising blood glucose levels despite high insulin secretion. Either of these defects may be the predominant feature in a particular case [28-31]. There is considerable debate and controversy as to whether it is insulin resistance or pancreatic beta-cell failure that initiates the cascade of events that culminates into type-2 diabetes. Whereas Martins *et al* [29] established that insulin resistance is the primary defect that precedes the development of type 2 diabetes mellitus, Banerji and Lebovitz noted that about 59 % of African-American type 2 diabetic patients do not exhibit insulin resistance even when diabetes is already manifest, [30] suggesting that pancreatic beta cell failure may be the predominant, if not the sole defect in a good number of type-2 diabetic African-Americans. We studied the pancreatic beta-cell function in type-2 diabetic patients in Zaria[32] using the homeostasis model assessment (HOMA) developed by Matthews *et al* [33].

In this model, the results of the computer-derived estimations of beta-cell function as a percentage of expected beta-cell function in lean young adults are the same as the values obtained from the simple mathematical equation below.

$$\textit{Percent beta-cell function} = 20 \times \frac{\textit{fasting plasma insulin(micro-units/L)}}{\textit{Fasting plasma glucose (mmol/L)} - 3.5}$$

In this study, we have demonstrated that type 2 diabetic Nigerians of Hausa-Fulani ethnicity exhibit much lower pancreatic beta cell function compared to control subjects.

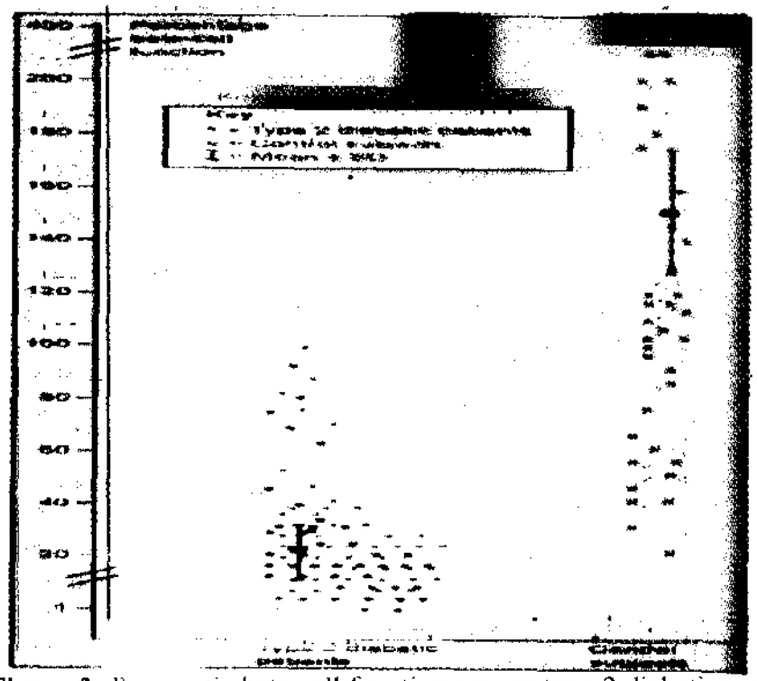


Figure 3: Pancreatic beta cell function among type-2 diabetics and controls in Zaria

This finding is expected, and similar to earlier findings elsewhere[28, 31, 33-35]. Studies in South African blacks suggest an early pancreatic beta-cell failure as the operative defect in black type-2 diabetic patients, which lead Joffe and Seftel [35] to postulate a decrease in the mass of functioning beta cells as a key factor. In our study however, it is impossible to suggest whether the observed pancreatic beta-cell failure is the cause of or is the result of type 2 diabetes mellitus, since it is known that hyperglycaemia causes as well as aggravate pancreatic beta-cell secretory failure[34]. However, since few of the control population demonstrated evidence of pancreatic beta-cell dysfunction (8.3% showing beta-cell function less than 50% of reference value), suggesting probable decreased beta-cell mass; an argument for the role of pancreatic beta-cell failure as the underlying defect in type 2 diabetes mellitus in this environment could be advanced. It is rational to assume that those with low beta-cell mass are likely to develop diabetes when challenged with the stress of urbanization and modernization, such

as sedentary life-styles, excessive calorie consumption and the attendant obesity all stressors that would lead to insulin resistance which an individual with low pancreatic beta-cell mass may not be able to cope with. Indeed this hypothesis is in tandem with our previous findings of low insulin levels both in the fasting state and in response to oral glucose challenge among the same population of patients[4]. It is also consistent with our observation that type-2 diabetic patients in this environment require insulin much earlier than reported in western literature (unpublished observation). On the other hand, we used the HOMA method to compute insulin resistance in 40 type-2 diabetic subjects and 36 controls. We found that the mean HOMA scores were significantly higher among type 2 diabetic subjects than controls. Ten (27.8%) of the control subjects demonstrated HOMA insulin resistance values greater than one compared to 35 (87. 5%) type-2 diabetic patients ($p<0$ .05). we concluded that although type-2 diabetic patients' in this study exhibit more insulin resistance than control subjects, insulin sensitive variants of type-2 diabetes is also found in our population.

Aetiology of Type 1 Diabetes

Type 1 diabetes results from autoimmune destruction of pancreatic beta cells. Like type 2 diabetes, its causation depends on both genetic and environmental factors [36-38].

Role of genes

Known susceptibility genes for type 1 diabetes are located in the immune response genes HLA. The common ones are HLA DR3 and HLA DR4 [36]. European populations are known to have higher rates of these genes compared to Negroid races. This may partially explain the relative lower incidence of type 1 diabetes in the latter compared to the former. However, it is important to note that the presence of the genes alone do not result in type 1 diabetes. An appropriate environmental stimulus is required to work in concert with the genes before type 1 diabetes becomes manifest.

Role of Environmental Factors

Genetic factors alone cannot explain the rapid rise in the prevalence of type 1 diabetes in the last 50 years or so. Several environmental factors have been implicated most of the agents

implicated are thought to act by the process of antigenic mimicry. Main factors implicated are viral infections e.g. Cocksackie B4, mumps, congenital rubella; and the role of early infant feeding with artificial formulas containing cow milk [37,38]. Cow milk universally contains Bovine serum albumin (BSA), which exhibits antigenic similarity with protein p69 of pancreatic beta cells leading to autoimmune serological and cellular reactions culminating in beta cell destruction[38].

Parasitic infestations are known to suppress auto-immunity and could partially explain the relative rarity of autoimmune disorders including type 1 diabetes in the tropical environment where parasitic infestations are endemic.

Pathogenesis

In a susceptible individual, an immune mediated destruction of the pancreas is initiated by an environmental event. This results in the reduction of total beta cell mass and a proportional increase in activity in normal beta cells to compensate for the deficiency. However, the increased activity renders the normal cells more susceptible to autoimmune destruction. Symptoms of diabetes mellitus become manifest when 80% to 90% of beta cells have been destroyed[36,37].

Clinical Presentation of Diabetes Mellitus

Individuals with diabetes mellitus present to the clinician in different ways, and up to half of diabetic patients may have no symptoms and are diagnosed incidentally[7]. Basically diabetic patients present for the first time to the clinician in one of the following scenarios.

i. During routine investigations (without any symptom).
ii. Patients seeking medical attention because of symptoms of diabetes with or without symptoms of diabetic complications (discussed below).
iii. Sometimes individuals may present with symptoms of one or more complications of diabetes.

Symptoms of Diabetes Mellitus

The following quotation from the ancient Indian literature probably gives the best description of the major symptoms of

diabetes mellitus. ***"The person who passes urine which is exceedingly sweet, cool, slightly viscid, turbid and resembling the juices of sugar cane. Suffers from glycosuria..There are two types. One due to genetic factors. The other due to indiscreet living or dietary indiscretions. The patient suffering from the former is thin, pale, eats less and drinks too much The patient with the latter is often obese eats a lot, is stout of sedentary habits and sleeps too much." Charka Samhita and Sushinita Ayurveda circa 100-200 BC.***

Although the symptoms of diabetes are protean, diabetic patients usually complain of the following symptoms at diagnosis.

Polyuria

This is technically defined as passage of more than three liters of urine per day. Polyuria results from the osmotic effects of glucose and other solutes e.g. ketone bodies that should normally be reabsorbed by the kidney tubules after filtration. When the absorptive capacity of the kidney is exceeded, i.e. when the renal threshold for these solutes has been surpassed (renal threshold for glucose is 10mmol/L or 180mg/dL), the excess is lost in the urine. Since these substances are osmotically active, water loss by the kidney tubules compulsorily accompanies their excretion. The result is excessive amounts of urine both during the day and at night.

Polydipsia

Polyuria results in net extra cellular fluid loss leading to dehydration and increase in serum osmolarity. To compensate for the excessive water losses in urine and to the high serum osmolarity occasioned by high levels of glucose in the blood and dehydration, the thirst centre is stimulated. This centre is situated at the anteromedial hypothalamus and is sensitive to small changes in osmolality (normally 290-300 mOsm/L).

Polyphagia

In the diabetic state, although there are excessive amounts of glucose in circulation, there is defective utilization of glucose and the other fuels such as protein and fat by insulin sensitive cells. As far as these cells are concerned therefore, there is a state of insufficient utilizable fuels in the system. In other words, there is

starvation in the midst of plenty. This leads to increased appetite to meet up with the supposed state of starvation.

Weight loss

As a result of insulin deficiency (relative or absolute) insulin sensitive cells are not able to utilize the basic source of energy notably glucose effectively. This result in the use of alternative sources of energy notably fat deposited in fat cells; and amino acids stored in the form of protein in skeletal muscle. Fat cells and skeletal muscle are broken down. However, even the energy from these alternative sources is not utilized efficiently in the setting of insulin deficiency in other words the energy also gets "misappropriated". Furthermore more and more of these precious sources of energy are lost in the urine leading to a net loss in total energy balance. The result is progressive weight loss despite good appetite.

Recurrent infections

Diabetic patients are more susceptible to both acute and chronic microbial infections as a result of defects of cell mediated and humoral immunity, as well as defective phagocyte function. These defects have a direct correlation with glycaemic control and improve with improvement in glycaemic control. Diabetic patients may present for the first time with recurrent infections.

Eye symptoms

Visual symptoms range from blurred vision to outright blindness and are usually due to high or rapidly changing levels of blood sugar, opacification of the lens (cataract) or retinopathy.

Impotence

Sexual problems are highly prevalent and bothersome for the diabetic person. In fact it may be the main reason for the consultation, and only after careful clinical evaluation; would the underlying diagnosis of diabetes be obvious. Impotence or more appropriately referred to as erectile sexual dysfunction in the male is a common complain among diabetics.

Poor Obstetric History

Women with diabetes experience reproductive abnormalities such as delayed menarche and increased incidence of menstrual

cycle irregularities as well as delayed ovulation leading to reduced fertility rates. Furthermore, they are at increased risk for recurrent abortions, and history of large healthy looking babies with neonatal deaths.

Foot sepsis/gangrene

Diabetes is the leading cause of non-traumatic lower extremity amputation. Diabetes foot sepsis may be the initial presenting feature of diabetes. Typically, this complication starts spontaneously with blisters occasionally following trivial trauma.

Loss of consciousness

Loss of consciousness could result from an acute complication of diabetes such as diabetic keto-acidosis, hyperosmolar non-ketotic coma or as a result of complications of therapy such as hypoglycaemia and lactic acidosis

Diagnosis

On the basis of data from three different populations aimed at identifying the fasting blood glucose levels that best predicted the risk of developing micro vascular complications, the ADA approved new diagnostic criteria for diabetes mellitus on the basis of recommendations from an expert committee in 1997. These criteria are symptoms of diabetes and a casual plasma glucose concentration of ≥11.1 mmol/l (≥200mg %) or a fasting plasma glucose value of ≥7.0 mmol/l (≥126mg %) or 2 hour plasma glucose value of ≥11.1 mmol/l (≥200mg %) during a standard 75 g. The WHO accepted these criteria in 1999. For clinical diagnosis, a second test is recommended for confirmation, while for epidemiological studies, the use of fasting plasma glucose levels of 7.0 mmol per liter alone is acceptable[1].

Complications of Diabetes

For the sake of convenience, it is easier to look at diabetic complications from the temporal point of view. Thus we talk of acute complications, which occur relatively over a short time frame, potentially life threatening; and may be precipitated suddenly by such factors as infections, psychosocial stress, injuries or side-effects of drugs used for the management of hyperglycaemia. Such

complications include diabetic keto-acidosis (DKA), hyperosmolar non-ketotic coma (HONK), lactic acidosis and hypoglycaemia.

On the other hand, chronic complications tend to occur over a relatively longer time frame, as prolonged hyperglycaemia appears to be required in their pathogenesis. Chronic complications are typically insidious in onset but relentlessly progressive unless metabolic control is achieved and maintained. However, it is important to note that since type-2 diabetes is typically asymptomatic in a large proportion of individuals and therefore undetected, chronic complications of diabetes may be the first manifestation of the condition.

Chronic Diabetic Complications

Not all patients with diabetes develop chronic complications regardless of their metabolic control. On the contrary, some patients develop chronic complications quite early even in the presence of only "mild" elevations of blood sugar levels. To explain these extremes, two hypotheses have been advanced. The metabolic hypothesis presupposes that chronic diabetic complications are as a consequence of hyperglycaemia in other words no hyperglycaemia no complications and the rates of their development are directly proportional to plasma glucose levels. The genetic hypothesis on the contrary considers diabetic complications as a result of the same gene(s) that caused diabetes in the first place in other words complications would occur irrespective of the level of glycaemic control. However, a midway hypothesis is most likely to be true rather than either of the first two hypotheses. This hypothesis suggests that while susceptibility to diabetic complications varies between patients, chronic hyperglycaemia appears to be a prerequisite for the development of these complications. Findings from the Diabetes Complications and Control Trial (DCCT) [41], a multi centre study involving 1441 type 1 diabetic patients from 28 centers followed up for 5-10 years has conclusively demonstrated that tight glycaemic control reduces the risk of retinopathy and nephropathy in the case of type 1 diabetes. Similarly, the United Kingdom Prospective Diabetes Study (UKPDS) [39] in the case of type 2 diabetes strongly supports this midway hypothesis.

The traditional chronic complications of diabetes are

- Neuropathy.

? Angiopathy
? Retinopathy
? Nephropathy.
? Diabetic foot.
? Musculoskeletal.

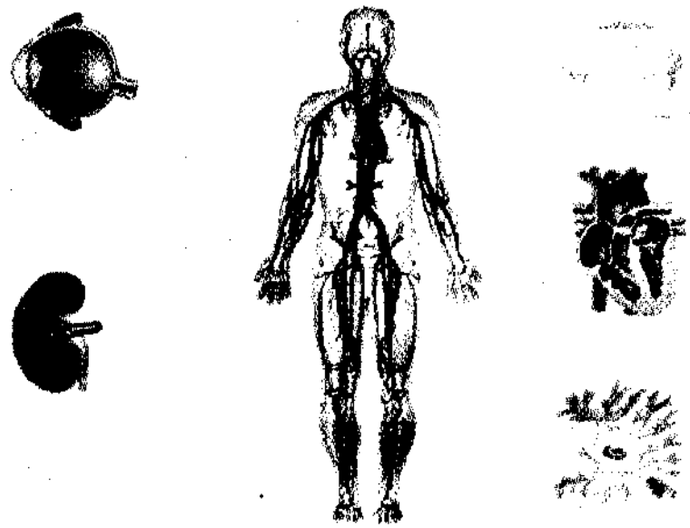


Figure 4: Systems affected by chronic Diabetic complications

Neuropathy

Peripheral and autonomic nerves are variably affected in diabetes mellitus and the consequent metabolic changes. This results in functional disturbances and pathologic changes in the nerves with resultant clinical symptoms and signs. Diabetic neuropathies present in several ways and are of varying severity.

Angiopathy

Atherosclerotic disease accounts for most of the excess mortality in patients with diabetes. In the UKPDS, fatal cardiovascular events were 70 times more common than deaths from

microvascular complications. The relationship between glucose concentrations and macro vascular events is less powerful than for microvascular disease; smoking, high blood pressure, proteinuria, and cholesterol concentration are more important risk factors for large vessel disease in patients with diabetes. The large vessel diseases present as ischaemic heart disease, peripheral vascular disease or cerebrovascular disease. Cerebrovascular disease could lead to acute brain infarction also known as stroke.

Stroke

The risk of thrombotic stroke is two to three times higher in patients with diabetes, but the rates of haemorrhagic stroke and transient ischaemic attacks are similar to those observed among the non-diabetic population. Patients with diabetes are more prone to irreversible rather than reversible ischaemic brain damage, and small lacuna infarcts are common. Unfortunately, stroke patients with diabetes have higher death rates, poorer neurological outcome and consequently more severe disability. However, maintaining good glycaemic control immediately after a stroke is likely to improve outcome although long-term survival is reduced due to high recurrence rates.

Visual Impairment

Eleven percent (11%) of community-dwelling adults with diabetes have impaired vision. This could be as a result of cataracts, refractive errors or retinopathy.

Retinopathy

Involvement of the retina is referred to as retinopathy; and it is a common complication of diabetes. Diabetic retinopathy is the principal cause of blindness in the adult population of most technologically advanced societies where it is adjudged the commonest cause of blindness in people aged 30-69, and by the year 2035 if the trend remains unchecked, it would be commonest cause of blindness globally[7]. Estimates of the prevalence of retinopathy vary, but epidemiological studies tend to suggest higher rates in those with earlier age of onset of type 1 diabetes. A fifth of patients with newly discovered type 2 diabetes have retinopathy at the time

of diagnosis while in type 1 diabetes, vision threatening retinopathy almost never occurs in the first five years after diagnosis or before puberty. However, after 15 years, virtually all patients with type 1 diabetes and two thirds of those with type 2 diabetes show evidence of background retinopathy and up to 75% of all people with diabetes will eventually develop retinopathy of some form. Therefore, the need for regular eye examination as a fundamental part of the routine care of all diabetic patients cannot be over emphasized.

Nephropathy

Diabetic involvement of the kidneys is referred to as diabetic nephropathy; and it is characterized by proteinuria $\geq$300 mg/24hours, increased blood pressure, and a progressive decline in renal function. At its most severe, diabetic nephropathy results in end stage renal disease requiring dialysis or transplantation, but in the early stages overt disease is preceded by a phase known as incipient nephropathy (or microalbuminuria), in which the urine contains trace quantities of protein (not detectable by traditional dipstick testing). Microalbuminuria is defined as urinary albumin excretion rate of 20-300 mg/24 hours or 20-200 µg/min in a timed collection.

The rate of decline in glomerular filtration rate varies widely between individuals. Fortunately, antihypertensive treatment especially with angiotensin converting enzyme (ACE) inhibitors even in normotensive patients slows the decline in renal function and improves survival among patients with diabetic nephropathy.

Diabetic Foot

The term "Diabetic foot" describes a multifaceted clinical problem both in aetiology and manifestations. Presentation is quite variable from foot ulceration to foot gangrene requiring amputation. Factors important in the pathogenesis of this complication are sensory neuropathy, angiopathy, infections, trauma and poor wound healing.

The "Diabetic foot" occurs globally with wide geographical variation. About 15% of people with diabetes have a foot ulcer during their life, in developed countries the annual incidence of foot ulceration is about 2-8% among the diabetic population, 85% of diabetes related amputations are preceded by a foot ulcer, 15% of

patients with diabetic foot ulcer may end up with an amputation. In developing countries, diabetic foot ulcers are unfortunately very common. This is often as a result of ignorance, poverty, bare foot walking, poor hygiene and most importantly feet not being examined by health care workers to detect the at risk foot and provide appropriate advice. In Zaria, diabetic foot sepsis is a major challenge and the commonest cause of hospitalization among diabetic patients. A retrospective review of case records of all patients admitted with diabetes foot sepsis at our hospital from January to December 2013, during which there was a cumulative strike period of 3 months by various health workers, a total of 142 diabetic patients were hospitalized during the period under review. Of this 44 (31%) of the patients were hospitalized as a result of diabetic foot sepsis. The age range of those who presented with diabetic foot sepsis was 32-75 years old. There was a male preponderance with 27 (61%) males and 17(39%) females. The right foot was affected in 21(48%) patients, the left foot was affected in 19(43%) while 4(9%) had bilateral involvement. Most of the patients presented with advanced disease, only seven (16%) had grade 2 disease, 14(32%) presented with grade 3 disease, 19(43%) presented with grade 4 disease while four (9%) presented with grade 5 disease. Five (11%) had below knee amputation while three (7%) died during hospitalization. It was concluded that diabetic foot sepsis is an important health problem in our environment there is need to identify those at risk early enough to prevent this potentially debilitating complication[40].

Pathogenesis of the Diabetic foot

The pathogenesis of events that could end up with a lower limb amputation or gangrene usually starts with the formation of a foot ulcer (break in the continuity of the skin). This is almost always preceded by impairment of or complete loss of sensation as a result of neuropathy. Sensory neuropathy results in failure to appreciate noxious stimuli such as pain, extremes of temperature and pressure, thermal, physical or mechanical trauma could go on unnoticed leading to ulceration. Ulceration in the diabetic foot could be complicated by super added bacterial infections; poor blood supply as a result of macro-angiopathy could impair healing as would oedema from local inflammation or autonomic neuropathy. Sensory

neuropathy should be actively sought for at each clinic visit; and patients with sensory neuropathy as well as other high-risk features need advice on foot care to minimize the risk of ulceration. To prevent diabetic foot complications, the diabetic is advised:

- Not to walk barefoot (always wear shoes.)
- Keep feet clean and moist (just as your face.)
- Use shoes that must give room for toes to move freely.
- Not to use hot water bottle on the foot.
- Never to remove corns or calluses personally.
- To examine feet daily.

Musculoskeletal Complications

Diabetes quite commonly affects the musculoskeletal system, resulting in significant morbidity. Several mechanisms may contribute to skeletal damage, including increased urinary excretion coupled with lower intestinal absorption of calcium, as well as the alteration of vitamin D regulation. Decreased or increased insulin and IGF-1 concentrations and the effects of the accumulation of glycation end products on bone tissue may also play a role. A possible genetic predisposition is also currently under investigation. As far as bone mass is concerned, in adult patients with type 1 diabetes a moderately reduced bone mineral density has been shown in both axial and appendicular skeleton. On the contrary, patients with type 2 diabetes seem to have higher bone mineral density in respect to healthy control subjects, especially when overweight women are considered. These manifestations may go undiagnosed or simply overlooked in daily clinical practice. However, symptoms may be severe and incapacitating. Fortunately, many of these complications are amenable to treatment with resultant improvements in the quality of life; it is therefore essential for patients and clinicians to be aware of the possible musculoskeletal complications of diabetes. The various musculoskeletal complications of diabetes mellitus are:

- Diabetic cheiroarthropathy.
- Flexor tenosynovitis.
- Dupuytren's contracture.
- Carpal tunnel syndrome.
- Frozen shoulder.
- Calcific periarthritis.
- Reflex sympathetic dystrophy.
- Diabetic osteoarthropathy.

- ***Diffuse idiopathic skeletal hyperostosis.***
- ***Muscle infarction.***

The Metabolic syndrome

Vice Chancellor Sir, distinguished audience. The changes in life style of our society characterized by excessive caloric intake and decreased physical activity does not only result in obesity and diabetes. It also results into a much more serious medical problem referred to as the metabolic or the insulin resistance syndrome. This is constellation of disorders such as hyperinsulinaemia, insulin resistance in the aetiology, central obesity, glucose intolerance, systemic hypertension, ischaemic heart disease, and peripheral vascular disease. Reaven in 1988[47], coined the term 'Syndrome X' to refer to the clustering of these conditions, and suggested insulin resistance as the underlying cause, and the resultant hyperinsulinaemia as being responsible for the components of the syndrome. This cluster, among other terminologies, is also referred to as the 'metabolic syndrome'. There is evidence to suggest that the prevalence and expressivity of this syndrome varies from one population to another and even within populations.

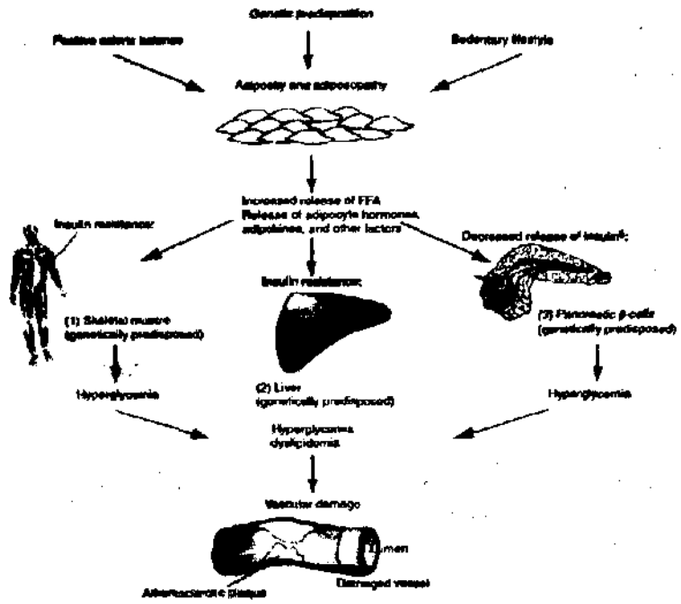


Figure 5: depicts the metabolic syndrome

The World Health Organization (WHO) has suggested a working definition of this syndrome in individuals with glucose intolerance, i.e. glucose intolerance with any two or more of: insulin resistance, arterial hypertension, central obesity or a body mass index (BMI) >30 kgM^2, dyslipidaemia, and microalbuminuria. Using this definition, we studied the prevalence of this syndrome among diabetics in Zaria.[11] Type 2 diabetic patients had higher waist: hip ratios (WHR) and body mass indices (BMI) compared to control subjects ($p<0.05$ and $p<0.01$ respectively). Components of the Metabolic Syndrome were common among type 2 diabetic Nigerians. Insulin resistance and central obesity were the most common, respectively occurring in 40% and 95% of type 2 diabetic Nigerians while hypertension occurred in 32%. There was a positive but statistically non-significant correlation between the various components of the syndrome. It is concluded that the Metabolic Syndrome is common among type 2 diabetic Nigerians. Table 1 and table 2 below shows the different components of the syndrome among the study population. Of particular note is the higher rate of obesity when defined using WHR implying that central obesity is more prevalent than when obesity is defined by calculating BMI. It is noteworthy that Vague[44] as early as 1947 has demonstrated that central obesity is much more injurious to health than peripheral obesity.

Table : components of the Metabolic Syndrome among type-2 diabetic in Zaria.

	Males	Females	Total	p value
Metabolic syndrome	10 (36%)	6 (50%)	16 (40%)	NS
Central obesity	26 (93%)	12 (100%)	38 (95%)	NS
Hypertension	7(25%)	6(50%)	13 (32%)	<0.05
Insulin resistance	10 (36%)	6 (50%)	16 (40%)	<0.05
BMI ≥30 Kgm^2	0 (0%)	2 (17%)	2 (5%)	<0.05

Central obesity = WHR >0.85 for females and >0.9 for males.
Insulin resistance = HOMA IR value >2.0.

Table : indices of obesity among diabetic and control subjects.

Anthropometric index	Type 2 diabetic patients			Control subjects			p value
	Males Number (%)	Females Number (%)	Total Number (%)	Males Number (%)	Females Number (%)	M...	
BMI (kg/m...							
WHR							...01

Management of Diabetes

The aim of therapy in diabetes is to improve the quality of life, achieve and maintain normoglycaemia, prevent hypoglycaemia and most importantly prevent acute and chronic complications of diabetes. The DCCT trial has conclusively shown that it is possible to achieve these objectives to a large extent[41]. To achieve these, life-style modification with or without some form of pharmacological (drug) intervention would be required. Non-drug modalities of therapy especially ***physical exercise*** and ***dietary modification*** have been recognized by physicians as far back as 600 BC to be beneficial in the management of diabetes. In the same vein, ***diabetic education*** is the corner stone of any successful management program, and is probably the most important tool to achieve optimal diabetic control. ***Diabetic education*** is therefore as important as any form of intervention[45,46]. Globally, there is no dissenting voice that diabetes education is a strong factor in achieving, and sustaining good glycaemic control; preventing diabetic complications and improving the quality of life for the diabetic individual[18].

Physical Exercise

Physical exercise is known to reverse insulin resistance and promote normal glucose homeostasis. Physical activity guidelines from the American Diabetes Association and the American College of Sports Medicine have suggested that intermittent moderate-intensity exercise is beneficial and can improve the health status of individuals with impaired glucose tolerance and diabetes[47]. Specifically, the guidelines recommend the accumulation of 30 minutes of moderate-intensity physical activity per day, and have

classified brisk walking (3–4 miles per hour), gardening, and general home-care activities as moderate-intensity exercise. It is important to stress that exercise does not necessarily mean a specific organized program such as playing tennis, weight lifting, jogging or using some form of equipment such as a treadmill. However, simply moving the body as in walking to places of worship, shopping or visiting relatives on foot provides as much health benefits as organized programs provided that the shorter bouts of physical activity add up to at least 30 minutes a day. In addition to improving insulin sensitivity, exercise could also help in a weight reducing program in overweight diabetic subjects' thereby further improving insulin sensitivity and glycaemic control. The following are *benefits of exercise:*

i. Improves insulin sensitivity.
ii. Helps in weight-reduction.
iii. Reduces plasma glucose levels.
iv. Relieves stress.
v. Helps to reduce high blood pressure.
vi. ↑HDL cholesterol, ↓LDL and Total cholesterol
vii. Reduces risk of stroke & heart attacks.
viii. Results in general feeling of well being

Dietary Management

Diet has long been recognized to play significant roles in the aetiology and sustenance of several illnesses. This is more so in diabetes[46], where dietary changes have been shown to play significant roles in its development. Dietary control inconcert with weight loss, and exercise would help reduce postprandial glycemia and assist in losing additional weight, as well as in optimizing risk management for macro-vascular disease, a common complication of the disorder[48,49].

There has been a significant change in the dietary advice given to diabetic individuals from what used to be preached. In the past, low-carbohydrate diets were widely publicized, and unfortunately, many patients and care providers are still holding on the erroneous notion that diabetics should take little or no carbohydrates. However, recent evidence and expert recommendations suggest that diets with severely restricted

carbohydrate content are not recommended for patients with diabetes. Such diets are fraught with the dangers of ketosis that may adversely affect renal function. Secondly and most importantly, patients who take insulin or oral tablets are at increased risk of hypoglycemia with low or no carbohydrate content meals. Furthermore, such diets often contain excessive amounts of protein, fat or both with attendant risks of cardiovascular and renal morbidity respectively. However, within the context of a balanced diet, individual food choices may have dramatic effects on blood glucose levels. Therefore, the key is to effective nutritional therapy in diabetes is individualization[49] .

Strictly speaking there are two forms of dietary intervention in diabetes: these are a measured diet and the unmeasured diet, the latter is what is practiced in our environment. In the measured dietary intervention, the amounts of calories to be taken daily are calculated and the source of that energy distributed among the major food classes (carbohydrates, protein and fat). In the unmeasured diabetic dietary intervention on the other hand, different foods are classified in to three categories those to be taken without restrictions such as vegetables, those to be taken in moderation this includes complex carbohydrates, protein and vegetable fat; and those to be out rightly avoided such as simple sugar containing foods such as candies, honey, cakes etc. This is the commonest form of advice given in most developing countries where it is not practicable to measure how much calories are being consumed at each meal. This has brought the concept of the Diabetes Food Pyramid (figure 6), which has six sections for food groups that vary in size. The largest group made up of grains, beans, and starchy vegetables are placed on the bottom of the pyramid. This implies that more of grains, beans, and starchy vegetables should be eaten compared to any of the other foods. The smallest group is placed at the top of the pyramid and consists of fats, sweets, and alcohol. This implies that very little or not at all from this group should be eaten. The general advice given to diabetics is:

- Eat a variety of foods.
- Balance food intake with physical activity
- Emphasize on grain products, vegetables, and fruits.
- Emphasize on diets low in total fat content.
- Advise a diet moderate in sugars.
- Reduce sodium intake.
- Increase potassium intake.

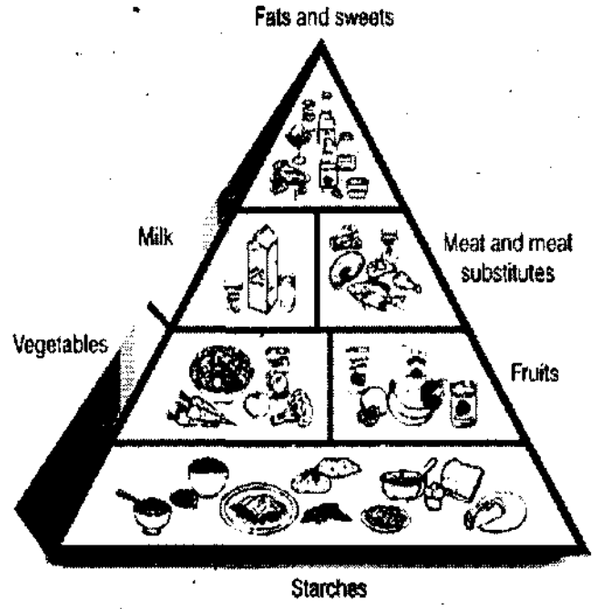


Figure 6: The Diabetic Food Pyramid

Variety is an essential component

Eating a wide variety of foods, even from the same food group should be emphasized. This helps to ensure that all required nutrients are ingested. For example: Within the fruit group, bananas are good sources of potassium while oranges are a good source of vitamin C.

Carbohydrate Intake

It is acceptable for the carbohydrate to be at a higher level provided that the food eaten is rich in soluble fiber and have a low *glycaemic index (GI). The* GI is a concept developed to rank foods based on the increase in blood glucose levels after the ingestion of 50 grams of carbohydrate from a test food, compared to a standard amount of 50 grams of white Bread. In other words, the GI of a particular food is defined as the area under the glucose response curve for that food compared with a standard control) the standard control is usually glucose or white bread.

The GI depends largely on the rate of digestion and rapidity of absorption of carbohydrate, the faster the rate of digestion and absorption, the higher the GI. It is possible to increase the amount of carbohydrate intake by increasing the intake of foods high in soluble fiber (legumes, lentils, some fruits, oats and barley) without adverse glycaemic consequences. Emphasis should therefore be placed on grain products, vegetables, and fruits. Carbohydrates such as grains, dried peas, beans, lentils; parboiled rice and many other staple foods of traditional cultures have low glycaemic indices and should be encouraged. It is advisable to eat grains, which should preferably be unpolished as polishing reduces the fiber content leading to higher glycaemic indices. These foods provide the least concentrated sources of calories and should provide the mainstay of the diet.

Immediately after eating a high glycemic index meal, serum levels of glucose, insulin, and incretin hormones increase dramatically. Within two to four hours following such a meal, blood glucose levels fall, leading to counterregulatory hormone release and increased free fatty acid release. The glucose excursion that follows a low vs high glycemic index meal directly affects postprandial glycemia. For example, the change in plasma glucose following ingestion of 50 g of spaghetti which has a GI of 41 is 50% of that seen following the ingestion of the same quantity of white bread which has a GI of 70 an hour after the meal. High glycaemic index foods such as soft drinks, ice cream and cookies provide large quantities of calories with little or no nutrients and should be avoided especially when weight reduction is intended.

Glycaemic load

Although central to the choice of food, the GI of food is not the only factor considered. Also considered is the glycaemic load (GL), which has been developed taking into cognizance both the quality and quantity of the carbohydrates consumed. Each unit of dietary GL represents the equivalent glycaemic effect of 1 g of carbohydrate from white bread, which is used as the reference food. High GL values are exhibited by such foods as low-amylose white rice, baked potatoes and corn flakes breakfast cereal. Some foods such as carrots and watermelon have high GI but low GL values. Since their GL are low these foods provide only a small amount of carbohydrate and hence could be ingested.

Protein Intake

The current guidelines recommend eating between 10% and 20% of required calories as protein. This is based on the fact that diabetics have similar protein requirements as the general population. Although the recommended daily allowance (RDA) for protein is 0.8 grams per kilogram of body weight; reducing protein intake to 0.6 g per Kg body weight per day could reduce albuminuria and improve renal hemodynamics in type I diabetes patients with incipient and established nephropathy. Such diets do not worsen blood glucose levels and do not lead to protein under nutrition. Suggestions that high-protein diets contributes to the pathogenesis of early diabetic nephropathy would be a very strong reason against high protein diets among people with diabetes in general. This is at variance to the old teaching where diabetics were advised on high protein diets. Furthermore, the preferred protein source is of plant rather than animal origin to reduce total fat and cholesterol intake. Vegetable proteins are generally less bioavailable, and may allow more overall intake in those with early nephropathy.

Sugars and Sweeteners

Ranges of non-nutritive sweeteners such as saccharin, aspartame etc. are available for diabetics and may be useful if added to drinks and cooking. Though aspartame is a dipeptide, it is intensely sweet and very little quantities are required to make food and drinks palatable. All these sweeteners provide useful means of reducing energy intake.

Vitamins and Minerals

Micronutrients have at one time or the other been the subject of interest in diabetes; however, there is no solid evidence that those with diabetes have different requirements for vitamins and minerals than those who do not have diabetes. Nevertheless, because of the increased frequency of hypertension and cardiovascular risks in diabetes, diabetic patients should be advised to restrict sodium intake to 6 grams per day or less, and in the setting of hypertension 3 grams per day. Similarly, increased potassium intake and sometimes-additional supplementation is particularly important when indicated, as this micronutrient has been shown to consistently lower blood pressure in population studies.

Though epidemiological evidence exists about the protective effects of antioxidant nutrients such as carotenoids, vitamin C, flavenoids, and tocopherols against coronary heart disease in non-diabetic individuals, recent evidence has shown conclusively that

supplementation with antioxidant nutrients such as vitamin E, vitamin C, and ß-carotene has no impact on cardio vascular outcomes and hence cannot be recommended routinely for diabetic patients. Rather, the emphasis should be on good glycaemic control; and control of the other well established risk factors such as obesity, dyslipidaemia, cessation of smoking, control of blood pressures etc.

Diabetes Mellitus in the Nigerian African

Vice Chancellor Sir, Fellow academics, distinguished guests. Diabetes mellitus presents a significant public health challenge in developing countries of Sub-Saharan Africa and Nigeria is no exception. Our community currently faces a double disease burden represented by increased rates of non-communicable diseases such as diabetes and hypertension; as well as endemic and emergent infections such as malaria, diarrheal diseases, tuberculosis, and HIV/AIDS.

In a survey of diabetes mellitus in Giwa and Makarfi local government areas of Kaduna state in 1996, we screened a total of 317 people aged 15-75 years. Diabetes occurred in five of the volunteers (1.6%) [50]. A few years later our colleagues from the Department of Community Medicine found a prevalence of 2.0% in Dakace village about 10 km from Zaria[51]. Equally more worrisome is the high prevalence of pre diabetes in the general population especially women[52]; suggesting that they have started the journey to become diabetic if remedial measures are not taken. In fact about 316 million people worldwide (6.9% of adults) were estimated to have IGT in 2013.[7] The vast majority (70%) of these people live in low- and middle-income countries, with the highest burden of IGT found among the Southeast Asian and European population with prevalence rates of 13.2% and 10.2% respectively while Africa was estimated to have a prevalence of 7.3%. By 2030, the number of people with IGT is projected to increase to 471 million (8.0% of the adult population) [7].

The increase in the number of people suffering from diabetes is linked to unhealthy ways of living and lifestyle such as consumption of excess calories, usually refined sugars in the form of soft drinks and snacks; and reduction in the level of physical activities with the consequent development of obesity and insulin resistance. Indeed the rampant consumption of soft drinks in our communities is obvious to all and sundry and often time's people are oblivious of the fact that large amounts of calories are ingested with every sip of these drinks. We have studied the sugar and caloric contents of the common soft drinks consumed in Zaria[53], and found

that they indeed contain high levels of calories. The result of excess caloric consumption coupled with a sedentary life style is obesity.

Obesity, type 2 diabetes mellitus, and their associated long-term complications are emerging as critical, worldwide public health problems. The cause of obesity in developing countries has been attributed to the current lifestyle, where urbanization, better economic development and an increase in income have resulted in diet changes referred to as nutritional transition[54], and less physical activity. In our community study we found that 13.1% of the subjects had obesity, while overweight was recorded in 18.5% (i.e. 36. % of the population had higher than normal BMI) of study participants[55].

Diabetes in the Nigerian African is characterized by predominance of type-2 diabetes as in the rest of the world, high prevalence of complications and poor blood glucose control. For example, a multicenter study across seven tertiary health centers in Nigeria[56] in which a total of 531 patients made up of 209 (39.4%) males and 322 (60.6%) females were enrolled, made the following findings. The mean age of the patients was 57.1 ± 12.3 years with the mean duration of diabetes of 8.8 ± 6.6 years. Majority (95.4%) had type 2 diabetes mellitus while 4.6% had type 1 diabetes. The mean FPG, 2-HrPP glucose, and glycated haemoglobin (HbA1c) were 8.1 ± 3.9 mmol/L, 10.6 ± 4.6 mmol/L, and 8.3 ± 2.2%, respectively. Only 32.4% and 20.4% patients achieved the ADA and IDF glycaemic targets, respectively. Most patients (72.8%) did not practice self-monitoring of blood glucose. Hypertension was found in 60.9%. Diabetic complications found were peripheral neuropathy in 59.2%, retinopathy 35.5%, cataracts 25.2%), cerebrovascular disease 4.7%, diabetic foot ulcers 16.0%, and nephropathy 3.2%. It was concluded that most Nigerian diabetics have suboptimal glycaemic control, are hypertensive, and have chronic complications of diabetes. This is similar to our findings in a ten year prospective collation of all cases of diabetes mellitus seen at our hospital, over a 10 year period[57]. Type-2 diabetes mellitus was the commonest form of the disorders encountered, chronic complications of diabetes mellitus were common, the commonest being peripheral neuropathy in 44% of cases, systemic hypertension in 25% of cases and diabetic foot gangrene in 2.8% cases.

There is a striking rarity of coronary artery disease among Nigerian diabetics despite poor control, and the presence of other risk factors such as hypertension and dyslipidaemia[58, 59]. This observation is perhaps as a result of the relative hypoinsulinaemia[60-63] and relative rarity of insulin resistance among our patients [2, 64].

Furthermore, the platelets of our diabetic patients are known to disaggregate even after aggregation.[65]

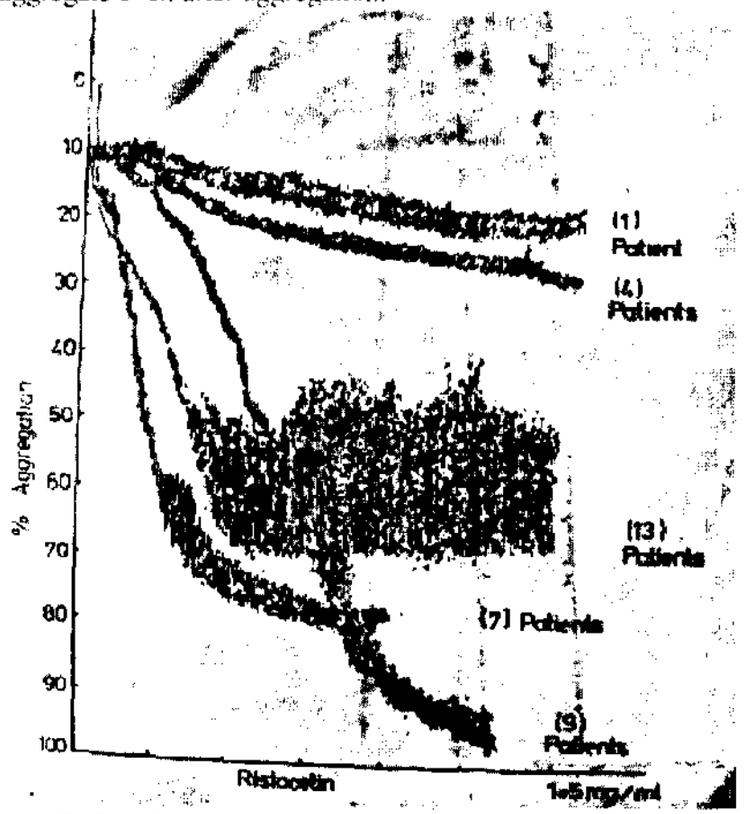


Figure 7: Platelet aggregation among diabetic and control subjects in Zaria

Challenges of managing diabetes mellitus in Nigeria

Managing diabetes in our environment is often challenging both for the patient, his family and indeed the health care provider as a result poverty, ignorance and poor health seeking behavior and inaccessibility of quality health care. Poverty, ignorance and poor health seeking behavior results in late presentation and is a possible reason why majority of our patients present with complications[56, 57, 66]. The impact of poverty, ignorance and poor health seeking behavior manifest more in diabetic children than adult diabetics, as it is possible that some, if not a significant majority of the affected

children succumbed to the illness at home out of parental ignorance and high cost of orthodox medical care. It is a daily routine in our hospitals for patients or their guardians to sign against medical advice and return home due to financial reasons, and or to seek alternative therapy or spiritual help[67].

Use of alternative and complementary therapy

Most of the time, the patients visit the local traditional healers before coming to the hospital [68-70]. Traditional medicine or complementary and / or alternative medicine (CAM) refers to health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to treat, diagnose and prevent illness or maintain well being[71].

The frequency of utilization of CAM is increasing worldwide and is well documented in both African and global populations to be between 20 to 80%[72]. Multiple therapy practices involving combined use of CAM particularly herbal medicines and prescription medications is prevalent in our population[69, 70]. Many herbal remedies have not undergone careful scientific assessment and some have the potential to cause serious toxic effects and major drug-to-drug interactions. Cultural and economic reasons are largely responsible for use of CAM. These include failure of modern medicine to cure the underlying problem and the perception that CAM is cheaper than conventional medicine. In countries like Nigeria, possible reasons for the use of CAM include the strong advertisement by alternative practitioners that CAM is a panacea to all diseases thus encouraging patients to try them. Another possible explanation is the cultural beliefs of Africans that illnesses have a spiritual origin. Patients are thus interested in finding an explanation for their symptoms or the root cause of their problems and therefore consult with alternative practitioners. In Nigeria, the use of herbal remedies which is perceived to be cheaper, is on the increase due to the poor economic state and the increasing costs of orthodox medicines as well as cultural reasons. Furthermore, the advertising strategies on the media and especially using vehicles with megaphone from one neighborhood to another, which do not inform but persuade customers, have also made the use more popular. Although several CAM practices and herbal remedies are promising

for diabetes treatment, further scientific studies are needed in order to establish safety, efficacy, drug-drug interactions and mechanism of actions of the herbs being used[72]. We studied the anti-diabetic potential of certain plant extracts in diabetic rats [73-75], and found them to have the potential of lowering blood glucose levels. Obviously further studies need to be done on these extracts. Furthermore, one of our PhD students is planning to study the effect of *moringa olifera on* the Pharmacokinetic Parameters of Metformin Hydrochloride in our Diabetic Patients. This would obviously throw more light on this subject in due course.

Prevention and Control of Diabetes Mellitus

Technically speaking, the prevention and control of diabetes mellitus could be discussed at three levels. These are primary prevention, secondary prevention and tertiary prevention.

Vice Chancellor Sir, distinguished audience it would not be out of place to start with the following quotation by A quote of Musa Ibn Maymun the Influential Andalusian Jewish physician and philosopher (March 30, 1135 Córdoba- December 13, 1204 Fostat, Egypt). Which is ***"Live sensibly- among a thousand people, only one dies a natural death, the rest succumb to irrational modes of living"***

Primary prevention

At this level, activities are geared towards reducing the incidence of diabetes in the community by the identification and appropriate management of known modifiable risk factors. This is cost effective in economic terms, as a slight change in the prevalence of these factors leads to significant changes in the prevalence of diabetes, which translates, into colossal sums of money saved. The known modifiable risk factors for all forms of diabetes are specifically targeted. Obviously, the strategy for the control of type1 diabetes would differ from that of type 2 diabetes; which would also differ from the strategy for the control of secondary diabetes.

Control of Type 2 Diabetes

As previously noted, type 2 diabetes mellitus is the commonest form of diabetes. Unfortunately, majority of diabetics

remain undiagnosed and even among those diagnosed, diabetes is often diagnosed relatively late in the course of the disease, at a point when many patients have already developed complications[7]. In addition, management is lifelong and challenging for both patients and physicians. Therefore, even slight changes in the incidence and prevalence of this form of diabetes would translate to significant changes in the overall incidence and prevalence of diabetes. Fortunately, major advances have been made in our understanding of the prevention of type 2 diabetes. Interventions that can reverse glucose intolerance early in its course may be the key to primary prevention of the long-term complications of diabetes[7, 11, 12, 71]. Clinical trials have convincingly shown that lifestyle modification is the most effective tool in the prevention or delay of type 2 diabetes[76]. For overweight and obese patients, a modest weight-loss goal of 5–10% (often < 20 lb) can substantially reduce the risk of diabetes. Moderate-intensity physical activity such as brisk walking for at least 150 minutes per week also plays an important role in reducing diabetes risk, even in the absence of weight loss. For patients who are unable to achieve these lifestyle goals or those who progress despite exercising and losing weight, metformin has also been proven effective, especially in younger obese patients. Acarbose, when tolerated at the maximum effective dose, may also confer a moderate risk reduction. Data regarding thiazolidinediones are conflicting, and the reports of cardiovascular and fracture risk make this option less attractive as a prevention strategy. However, none of these medications are as robust in diabetes prevention as the lifestyle intervention strategies, and cost-effectiveness analyses suggest that pharmacotherapy may have greater financial costs. Prevention of diabetes is our most powerful intervention, and successful implementation of these proven strategies should be the main focus. One of the earliest studies conducted in a Chinese community involving 577 men and women with impaired glucose tolerance were randomized to a program of diet, exercise, or both. Dietary intervention focused on increased amounts of vegetables and reduced consumption of alcohol and simple sugars: overweight individuals (those with a BMI > 25 kg/m2) were encouraged to lose weight[11]. The exercise group was instructed to increase their daily activity by the equivalent of 20 minutes of moderate activity, such as brisk walking, and the diet-plus-exercise group was asked to do

both exercise and dietary modification. After 6 years of follow-up, all three interventions were similarly effective, with risk reductions of 31–46% compared to an untreated control group. Similarly, the Finnish Diabetes Prevention Study (DPS) [77] randomized 522 overweight (average BMI 31 kg/m2) middle-aged individuals to either intensive lifestyle modification or a control group. Life style modification entailed both specific dietary recommendations and exercise guidelines with a weight-loss goal of 5% of total body weight; and at least 30 minutes of combined aerobic activity and resistance training daily. This study demonstrated a clinically significant impact of intensive lifestyle changes in the reduction of diabetes. At the 3-year follow-up, the group reduced their cumulative risk by 58% compared to the control subjects. During the first year, the intervention group lost an average of 4.2 kg, which appeared to be the primary mediator of diabetes risk reduction. Further analysis demonstrated the impact of exercise on the risk reduction of diabetes: moderate to vigorous activity of at least 2.5 hours per week reduced the incidence of diabetes by 63–69%. In the extended follow-up (3 years after the active intervention was completed), the intensive lifestyle group maintained a 36% relative reduction in diabetes incidence, suggesting that these benefits could be maintained outside of a structured clinical trial setting.[71]

Similarly, the Diabetes Prevention Program (DPP) [12], the largest study on lifestyle intervention for the prevention of diabetes to date randomized 3,234 overweight participants with impaired glucose tolerance and elevated fasting glucose in the United States to one of three interventions: intensive lifestyle intervention (ILS), metformin, or placebo. The ILS group was instructed to follow a low-calorie, low-fat diet, with a weight-loss target of 7% of baseline body weight and an exercise goal of at least 150 minutes per week of moderate-intensity physical activity. The ILS group participated in a 16-week core curriculum focused on behavior modification, diet, and exercise education during the first 24 weeks, followed by at least monthly reinforcement. After an average follow-up of 2.8 years, the ILS group achieved a mean weight loss of 7%, and three-fourths of the participants met the exercise targets during the first 6 months of the study. The ILS group had a 58% reduction in the development of diabetes compared to the placebo group. Weight loss was the predominant predictor of reduced diabetes incidence,

with a 16% reduction of developing diabetes for each kilogram of weight lost. However, participants who did not achieve their weight-loss targets but were able to achieve the exercise goal also benefited (44% risk reduction compared to placebo). The effectiveness of the ILS intervention was similar in men and women and among racial and ethnic groups. Recommendations for life style modification are summarized in table 3 below.

Table 3: recommended life style modifications[76]

1. Moderate level physical activity such as brisk walking for at least 30 minutes per day, 5 days per week.
2. Weight loss of 5-15% of starting weight with 1-2lb weekly.
3. Limit fat intake to <30% of daily caloric intake.
4. Reduce portion sizes and daily caloric intake.
5. Increase intake of fruits, vegetables and fibre in diet.

Secondary prevention

Results of the DCCT studies have important implications for preventing diabetes complications in people with diabetes mellitus. The DCCT study compared the effects of standard control of blood glucose versus intensive control on the complications of diabetes. Intensive control meant keeping HBA1C levels as close as possible to the normal value of 6 percent or less. The study concluded that intensive control significantly reduces the rates of chronic complications meaning complications of diabetes are to a large extent preventable by appropriately controlling blood sugars. Specifically, eye disease 76% reduced risk, kidney disease 50% reduced risk and neuropathy 60% reduced risk.

Since up to half of people with type 2 diabetes have vascular complications at the time of diagnosis and since the development of chronic diabetic complications is a function of the duration and severity of hyperglycaemia, early detection of diabetes is therefore essential. Several international recommendations from authoritative bodies support screening for type 2 diabetes as the benefits of early diagnosis in asymptomatic individuals will outweigh any harm associated with screening, early diagnosis, or the side effects of early therapy[7]. Screening (by way of measuring fasting blood glucose levels) should be considered for high risk patients, especially those who are middle aged and obese, have a history of gestational

diabetes, or have a family history of diabetes. These are summarized in table 4 below.

Table 4: recommendations for screening for Diabetes and Prediabetes[76]

1. Screening should be considered in all adults that are overweight(BMI>25kg/m^2) and have the following additional risk factors: ❖ Physical inactivity. ❖ First degree relative with diabetes. ❖ Women who deliver large babies (birth weight >3.5kg) or were diagnosed to have GDM. ❖ Hypertension. ❖ HDL cholesterol <35mg/dl or triglyceride >250mg/dl. ❖ HbA1C >5.7%, IGT or IFG on previous testing. ❖ Other conditions associated with insulin resistance such as polycystic ovary disease, acanthosis nigricans, severe obesity e.t.c. 2. In the absence of the above criteria, screening should begin at age 40-45 years. 3. If results are normal, repeat screening at least at 3-yearly intervals with more frequent testing if indicated.

Recommendations

Vice Chancellor Sir, distinguished audience, it is obvious that we are today facing an epidemic of diabetes as a result of drastic changes in our lifestyles from that bequeathed to us by our forefathers. The need to retrace our steps cannot be overemphasized. There is the urgent need for concerted efforts by governments, communities and educational institutions to key into preventive measures to curb this epidemic that if left unchecked could paralyze economic and social development of our society. The following measures would certainly help to reduce the menace if implemented:

i. Vigorous public enlightenment campaigns on the need to as much as possible avoid refined and fatty foods and encourage the consumption of boiled foods instead to reduce total caloric intake and reduce the risk of obesity in the community. Public enlightenment is also necessary on the need for the community to consume grains such as corn,

sorghum and millet unpolished, as polishing reduces the fibre content and increases the glycaemic index of the grains.

ii. Regulatory authorities must put in place measures to encourage active life style in the community and schools. The ministry of education should as a matter of policy insist that to be licensed, a school must have adequate space and provision for recreation by pupils and at least 30 minutes per day must be provided for in the time table for sports.

iii. Governments at all levels, pharmaceutical companies, communities and non-governmental organizations (NGO) such as the Diabetes Association of Nigeria (DAN) should put in measures to periodically and at regular intervals, put in place all necessary measures to screen the population at risk of diabetes and prediabetes to ensure early diagnosis and management.

iv. There is need to train and retrain middle level and specialist manpower to properly identify and manage diabetes to reduce the prevalence of both acute and chronic complications of diabetes.

v. Diabetic medications especially insulin are life saving drugs and should be seen and treated as such. There is therefore the urgent need to make them both accessible and affordable for all that require them. Government, NGO and philanthropic individuals would do well if at least insulin could be made available and free for all insulin requiring diabetics.

vi. The University should as a matter of urgency consider the setting up of a diabetes institute with the sole mandate of training middle level and senior manpower for our health system as well as research into the peculiarities and opportunities that exist in our traditions and culture that could tame the diabetic epidemic. The International Diabetes Federation (IDF) and the WHO would be willing partners and funders for such an institute.

The Vice Chancellor Sir, distinguished guests, thank you for your kind attention and may God Almighty save us from the evil of gluttony.

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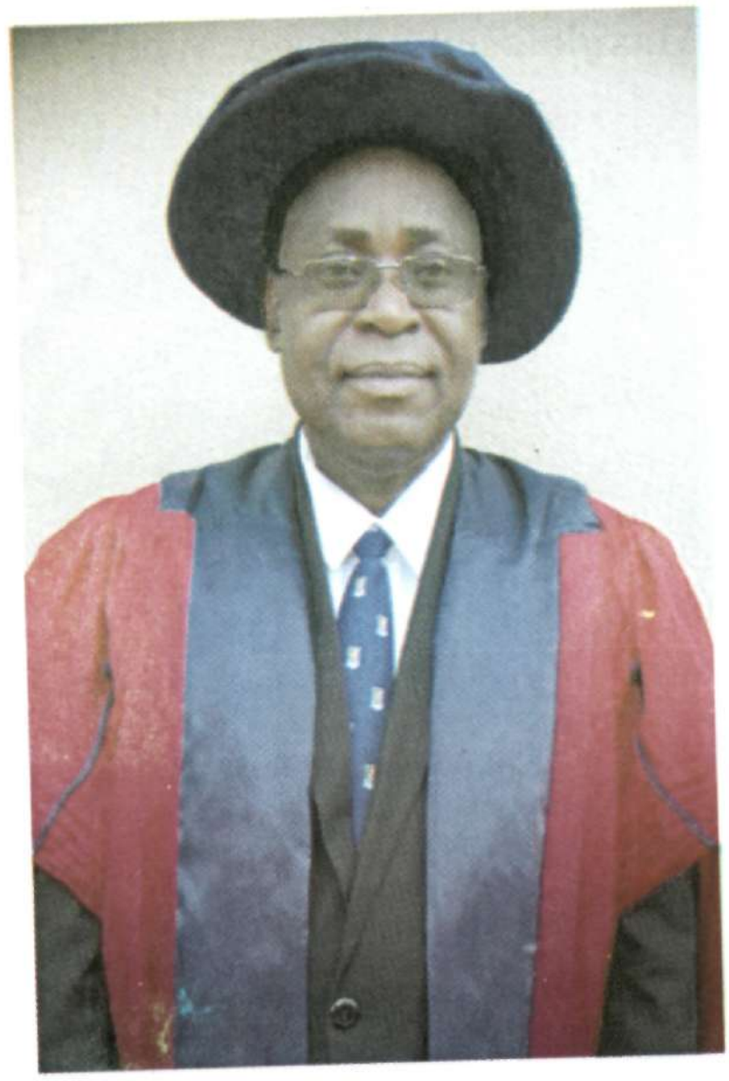
Chapter Ten

Maxillofacial Surgeon: Where Are You?

Maxillofacial Surgeon: Where Are You?

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To all the authors cited in this presentation, I say thank you for your contributions to human development. To this great audience, am most grateful for giving me your listening ears for without you this occasion would not have taken place.

Finally to all the people I have met during my life's journey, I remain eternally grateful to you for making it what it has been.

Preamble

I thank the Almighty God and the authority of Ahmadu Bello University, Zaria, and the Faculty of Medicine of this great university and my Department for affording me the opportunity to deliver this inaugural lecture on behalf of the Faculty. I am aware that this is the fifth lecture from the Faculty of Medicine and the first from the Department of Dental Surgery. I pray that it should also be the last. Not that I do not wish others behind me well but rather wish they would present under the Department of Maxillofacial Surgery, Faculty of Dental Surgery, College of Medicine, Ahmadu Bello University, Zaria in the nearest future.

The purpose of an inaugural lecture like this is to allow the lecturer to showcase his journey and contributions made to the academic world, Mr. Vice-Chancellor Sir, it is on this premise that I intend to take this august gathering through my journey as an academia in the Maxillofacial Unit, of the Department of Dental Surgery from 1995 to date, and while doing this, I will try as much as possible not to spice this lecture with excessive medical and maxillofacial jargons.

Casting my mind back to my childhood days particularly during my secondary school sessions revealed that the choice of carrier was between medicine and engineering, (architecture to be precise) and piloting. At the interview for my A-level admission in 1979, the vice-principal of CMS Grammar School, Bariga, Lagos asked me: "Young man, Biology or Mathematics?" and while still thinking of what to say, I was pushed to biology class, thus setting the pace for my journey into the medical world.

During my first year, in the A-level class, I sat for JAMB with the premier University, University of Ibadan as my first and second choices, and Dentistry as the only choice for course of study.

I was admitted into Dentistry in October 1980 and graduated in October 1986. Initially, I was interested in conservative dentistry where the money is, but soon realised that I will be bored filling teeth and coupled with the limited facilities for training in the specialty then. With these I had a re-think to consider another specialty.

Why maxillofacial Surgery of all the subspecialties in Dental Surgery? Mr. Vice-chancellor Sir, this was based on the influence of some of my lecturers, the charismatic Dr. Toks Abiose, Prof. Lawoyin JO, Prof. Lawoyin DO and off course the most luring to maxillofacial surgery was by Prof Adekeye EO, the first professor of oral and maxillofacial surgery in the Department whom I often refer to as the oracle of maxillofacial surgery during one of his lectures to the post graduate students of the west African College of Surgeons which I was opportune to attend in 1986 as a final year student. I was captivated and mesmerized during his description of the Bakamjian flap which I later came to realize is the deltopectoral flap. This eminent scholar eventually became my mentor.

Sir, you may ask why the choice of the title: **Maxillofacial Surgeon: where are you?** Why not 'By their teeth ye shall know them' after this entire lecturer is from the Department of Dental Surgery or 'by their faces ye shall know them', as this is related to maxillofacial surgery under which I have practiced for 19 years or why not ''the bold and the beautiful faces in Kaduna''

One of the reasons for this is because the population knows little or nothing about Maxillofacial Surgery, usually upon my being introduced as a maxillofacial surgeon I am often asked a battery of questions, such as: what do you really do? How is it different from plastic surgery? and so forth and I am quick to always remind them of the importance of the face and in particular the oral cavity, more also, that the first maxillofacial surgeon was actually the Son of God, Jesus Christ who died for you and me. Furthermore, the word ''face'' is mentioned in the Holy Bible 444 times thus showing its importance while ''teeth'' (its actions and effects) are mentioned only in 46 verses.

Another is to show the inter-relationship and the thin divide between the subspecialties working in the maxillofacial arena.

Oral and maxillofacial Surgeon, where are you? While not playing the role of the Almighty God as it in is in Genesis 3: 19. I

dare ask this question which will be of tremendous interest to this distinguished audience as we review the scope and practice of oral and maxillofacial surgery in our university and the world at large.

The oral and maxillofacial region.

The mouth, also called the oral cavity, is bounded laterally and in front by the alveolar process (containing the teeth, posteriorly by the isthmus of fauces, superiorly or the roof by hard palate and soft palate and inferiorly or the floor of the mouth by the mylohyoid muscles, occupied mainly by the tongue (German and Palmer, 2006; Probst et al., 2006) (Fig. 1). The tongue is one of the most powerful organs in the body, a claim the Holy Bible attests to as it appears in 160 verses. What would the world be like without a tongue? (Fig. 2).

Fig 1. Anatomy of the oral cavity

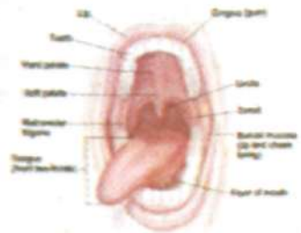


Fig 2. The mouth without a tongue



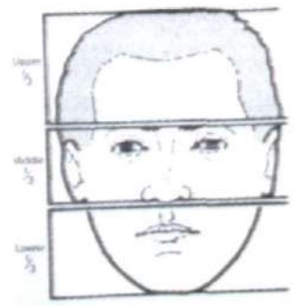
The mucous membrane lines the sides and under surface of the tongue to the gum lining the inner aspect of the mandible. It receives the secretions from the submaxillary and sublingual salivary glands.

The face or maxillofacial region is the portion of the body that occupies the region between the hairlines superiorly and the chin inferiorly (Larrabee et al., 2004; Prendergast, 2013) and between the ears (Sinnatamby, 1999) (Fig. 3a).

Fig 3a. Maxillofacial region.



Fig 3b. Division of the face into three parts.



The face is the object of attraction in the human depicting the personality. It is an important physical feature for complex social interaction in our everyday life (Bhattacharya, 2012). It is the central focus in all our everyday interpersonal relationships. It depicts the psychological state of the individual and is the physiognomy of an individual. The face gives an impression and expression of the human. However, according to Shakespeare's Macbeth, " there is no art to find the mind's construction in the face". Hence distortion of the facial tissues whether due to trauma or oncological services requires the services of a maxillofacial surgeon.

The face though, small in size is mighty in position as it harbours important organs for smell, sight, hearing and taste. It is the object of beauty and attraction or otherwise, it depicts an individual's personality. The face is divided into three parts; the upper third, the middle third and the lower third (Fig. 3b).

What is oral and maxillofacial surgery? Oral and maxillofacial surgery is defined as that part of Dental Surgery which deals with the diagnosis, surgical and adjunctive treatment of diseases, injuries and defects of the human jaws and face, the oral cavity and the associated structures (Srinivasan, 2004). It has strong identification with dentistry and surgery. Oral and maxillofacial surgery is strongly associated with the other surgical specialties as it is based on similar surgical principles.

Who then is an oral and maxillofacial surgeon? An oral and maxillofacial surgeon is a regional specialist surgeon treating the

entire craniomaxillofacial complex: anatomical area of the mouth, jaws, face, skull, as well as associated structures.

Some surgical treatments performed on the craniomaxillofacial complex include:

a. Dentoalveolar surgery (surgery to remove impacted teeth, difficult tooth extractions, extractions on medically compromised patients, bone grafting or preprosthetic surgery to provide better anatomy for the placement of implants, dentures, or other dental prostheses).
b. Surgery to insert osseointegrated (bone fused) dental implants and maxillofacial implants for attaching craniofacial prostheses and bone anchored hearing aids.
c. Cosmetic surgery of the head and neck: (rhytidectomy/facelift, browlift, blepharoplasty/Asian blepharoplasty, otoplasty, rhinoplasty, septoplasty, cheek augmentation, chin augmentation, genioplasty, oculoplastics, neck liposuction, lip enhancement, injectable cosmetic treatments, botox, chemical peel, etc.)
d. Orthognathic surgery: Surgical treatment and/or splinting of sleep apnea, maxillomandibular advancement, genioplasty.
e. Tumours and cysts: Diagnosis and treatment of benign pathology (cysts, tumors etc.), malignant pathology (oral & head and neck cancer) with (ablative and reconstructive surgery, microsurgery), cutaneous malignancy (skin cancer).
f. Treatment of congenital craniofacial malformations such as cleft lip and palate and cranial vault malformations such as craniosynostosis, (craniofacial surgery).
g. Chronic facial pain disorders.
h. Management of temporomandibular joint (TMJ) disorders.
i. Soft and hard tissue trauma of the oral and maxillofacial region (jaw fractures, cheek bone fractures, nasal fractures, LeFort type fractures, skull fractures and eye socket fractures).

Historical review of Oral and Maxillofacial Surgery

At the beginning, Dentistry was confined to the mechanical aspects of the teeth while the surgical aspects of the oral cavity were cared for by general surgeons. You may be surprised to learn that oral surgery has roots that trace all the way back to between 500-300

BCE, when historians found writings from Hippocrates and Aristotle discussing the practice of everything from tooth extraction to wired jaws and teeth. Later in 1210 CE, a group of barbers in France formed a group of surgeons that were separated by advanced and less advanced surgeries. The group is one of the earliest known oral surgery organizations.

The modern history of oral and maxillofacial surgery originated with the American Civil War. The World Wars and the surgical care for battle field injuries brought about dramatic advancements in surgical techniques and anesthesia. Most of the modern techniques came out of the lessons of that era coupled with the great scientific advancements since World War II. Although the oral surgery field has made many improvements, the constant improvement in materials, methods and nanotechnology hold great promises for the future. The 1900's showed great advances in industry and science. By the early 20th century, dentists limited to extractions and minor dentoalveolar surgical procedures were recognised which subsequently gave birth to the Society of Exodontists in 1918. Some members of the society pioneered cleft palate and other facial reconstructive surgery. During that time too, revolutionary advancements were made in the treatment of facial fractures for the Union and Confederacy. Their innovations continued through the 1920s, when they pioneered many of the procedures that serve as the foundation for cosmetic surgery today and thus formed the basis for the specialty called the oral and maxillofacial surgery today. As the 20th century progressed, oral and maxillofacial surgeons developed many current trauma techniques through their experiences with the dire injuries of soldiers in World War II, Korea, Vietnam and the Gulf War.

The earliest full-fledged maxillofacial surgical unit was established during the period of the Nigerian civil war as the Maxillofacial Army to take care of the battle casualties. After the civil war it became known as Maxillofacial Unit under the Department of Surgery, Ahmadu Bello University and Ahmadu Bello University Teaching Hospital then in Kaduna. The unit was subsequently excised from the Department of Surgery to form the present day Dental Surgery Department when a Departmental Chair was approved. As in many other countries, the oral and

maxillofacial Unit was established to manage battle casualties from the civil war.

What is the goal of oral and maxillofacial surgery?

The goal is the correction of facial deformity, eradication of facial surgical diseases, prevention of recurrence or complication and the restoration of function.

Scope of oral and maxillofacial surgery.

To understand the scope of oral and maxillofacial surgery, there is need to evaluate its relationship with other specialties in dental surgery and medicine as a whole. In the dental sphere, it is related to the orthodontics in the management of malocclusion, either by prevention or correction of the jaw deformities, to implantology and prosthetics. The specialty assists in the surgical preparation of the oral cavity for placement and better function of the prosthesis. Based on consultation with periodontics and conservative dentistry, oral and maxillofacial surgeons perform surgeries to treat gum and teeth diseases.

Many of our patients and even some of my colleagues may not be aware of the relationship between oral and maxillofacial surgery and the medical conditions. Indeed a strong relationship exists between the maxillofacial surgeon who deals with both the skin ''rubber'' and the bone and the plastic surgeon who deals with only the rubber part. A true relationship also exists between the general surgeon from whom all surgical specialties revolted my closest neighbours being the ophthlamologists and the otorhinolaryngologist as well as the orthopaedic surgeons, not forgetting the gynaecologist who works in the southern hemisphere in the tunnel but shares through divine arrangement the same epithelium with my main surgical field, the oral cavity. Similarly, I may not be able to perform any surgical procedure in the OR if I fail to recognise the 'marital' relationship between the maxillofacial surgeon and the 'almighty' anaesthesiologists with whom we struggle for the air space of the patients (Fig. 4).

Fig. 4. The close relationship between the anaesthesiologists and the maxillofacial surgeon as they struggle for airway.



In actual fact, with the exception of the OB Gyn and the anaesthesiologists, many specialties work in discrete surgical areas but often compete with one another. As each specialty justifies its existence the surgical boundaries become ill-defined but with collaboration from these same surgical specialties in the surgical arena of the face the post-operative results become fruitful and beneficial to the patient.

Just like the Biblical plaguing of the Land of Egypt in Exodus 7, the maxillofacial region may become plagued by various surgical diseases which are ignorantly attributed to punishment by 'a god' who is believed to be angry at them or the land. Such belief leads to initial resort to appease such local 'gods' or seeking intervention from the use of local herbal medications and charms. Neglect and ignorance of allopathic remedies result in turning the region of beauty and attraction to an area of trepid fear resembling that of a masquerade (Fig. 5).

Fig. 5. Various disfigurements as a result of maxillofacial diseases.



The scope of this specialty varies from country to country and also depending on the training and skill of the individual practitioner **(Ajike et al., 2004;** Adebayo, et al., 2008) (Tables 1). These 2 papers reviewed 87 and 86 patients from Kano and Port Harcourt respectively. Indications for maxillofacial interventions included tumours, cysts, traumatic conditions, congenital malformations and the presence of foreign bodies. The procedures performed were enucleation, excision and resection of tumours, closed reduction of fractures with maxilla-mandibular fixation, reconstructions and exploratory procedures. From my experience, trauma remains the most common cause of maxillofacial surgery. As for treatment, use of simple arch bars/eyelets is effective in the reduction and immobilization of jaw fractures. .

As an over view of the scope, Ajike et al in 2004, reviewed the spectrum of oral and maxillofacial surgical procedures seen between 2001 and 2003 in Aminu Kano Teaching Hospital, Kano. The indications for treatment in 87 patients were maxillofacial fractures and tumour ablation (Table 1). A total of 87 patients had 98 various surgical procedures (primary and secondary) (Table 2). The age range was from 3 days to 90 years with a gender distribution of 56 males and 31 females. The most common complication was malocclusion (n=14, 29.8%), facial defects and others (Table 3). Seven (58.3%) of the 12 facial defects were

observed following resection with disarticulation. The secondary surgical procedures were carried out to correct some of the complications (Table 2).

Table 1. Diagnosis/indications for surgery

Diagnosis	no	%
Odontogenic tumours		
Ameloblastoma	4	4.6
Amelobastic fibroma	1	1.2
Cysts		
Odontogenic keratocyst	1	1.2
Dentigerous cyst	1	1.2
Dermoid cyst	2	2.3
Frontal sinus cyst	1	1.2
Fibro-osseous lesion		
Ossifying fibroma	2	2.3
Fibrous dysplasia	1	1.2
Cementifying fibroma	1	1.2
Salivary gland tumours		
Pleomorphic adenoma (parotid)	5	5.7
Spindle cell carcinoma(submandibular gland)	1	1.2
Ectopic salivary gland	1	1.2
Non odontogenic tumour		
Osteosarcoma	1	1.2
Giant cell granuloma	1	1.2
Congenital		
Cleft lip and palate	8	9.2
Ankyloglosia	2	2.3
Trauma		
Mid third fracture	7	8.0
Mandibular fracture	24	27.6
Zygomatic complex fractures	5	5.7
NASAL COMPLEX fractures	1	1.2
Soft tissue injury/avulsion/laceration	9	10.3
Ectropion eyelid	1	1.2
Contracture	1	1.2
Osteomyelitis	2	2.3
Bilateral TMJ dislocation	1	1.2
Ankylosis	1	1.2
Collapsed anterior frntal bone	1	1.2
Foriegn body in the cheek	1	1.2

Total	87	100%

Source: Ajike et al. West Indian Med J **2004**; 53: 9-12.

Table 2. Primary and secondary surgical procedures

Surgical procedures	No	%
Enucleation	2	2.2
Resection with disarticulation	7	7.7
Repair	8	8.8
Excision	6	6.6
Surgical shaving	1	1.1
Release of contracture	1	1.1
Reduction and immobilization	21	23.3
Suturing	7	7.7
Debridement	3	3.3
Parotidectomy	5	5.5
Transoseous wiring	12	13.3
Percutaneous approach	2	2.2
sequestrectomy	2	2.2
Release of ectropion and skin grafting	4	4.4
Coronoidectomy	1	1.1
Acrylic cap splint	2	2.2
Release of ankyloglosia	1	1.1
Onlay graft (alloplastic)	1	1.1
Removal of foreign	1	1.1
C-shaped ostectomy	1	1.1
Inverted L-shaped osteotomy	1	1.1
Bicoronal flap	1	1.1
Total	90	100.0

Indications	secondary surgical procedures	No	%
Loss of mandibular Segments	autogenous iliac bone crest graft	1	12.5
Loss of mandibular Segments	insertion of Steinmann's pin	1	12.5
Wound breakdown	secondary suturing	1	12.5
Wound breakdown	skin grafting	1	12.5
Malunion with Aperthognathia	refracture with transosseous wiring	1	12.5
Oronasal fistula	repair	1	12.5
Parotid duct fistula	cannulation and repair	1	12.5

Total	8	100

Source: Ajike et al. West Indian Med J **2004**; 53: 9-12.

Table 3. Post-operative complication

Complications	**No**	**%**
Facial nerve weakness/paralysis	3	6.4
Parotid fistula	2	4.3
Oronasal fistula	1	2.1
Wound break down	2	4.3
Malunion	1	2.1
Post traumatic headache	2	4.3
Trauma (burns) to lip from surgical drill	1	2.1
Drooling of saliva	4	8.5
Speech difficulty	3	6.4
Immobility of tongue	2	4.3
Facial defect	12	25.5
Malocclusion	14	29.8
Total	47	100.0

Source: Ajike et al. West Indian Med J **2004**; 53: 9-12.

The paper concluded that trauma was the most common and use of simple arch bars was effective in the reduction and immobilization of the fractures. Reconstructive surgeries of ablated jaws were advocated in view of the aesthetic and psychosocial effects that they have on the patients.

Developmental anomalies of the oral and maxillofacial region

Developmental anomalies are defects that occur as a result of alterations to the normal development and growth of a body structures. They may manifest at birth (congenital) or appear later in life. Several terms are used to describe congenital abnormalities e.g. birth defects, congenital malformation, congenital anomalies, congenital disorders. Congenital anomalies can be defined as structural or functional anomalies, including metabolic disorders, which are present at the time of birth (WHO, 2014).

Developmental diseases result from different factors; some diseases are transmissible from parents to offspring (hereditary) (Fig. 6) (Ogunrinde et al., 2012), while others are caused by environmental changes (aquired).

Fig. 6. Hereditary ectodermal dysplasia. The patient would need ophthalmologist, implantologist prosthodontist, physician.



According to the Centre for disease control and prevention, most birth defects are believed to be caused by a complex mix of factors including genetic, environmental, and behavioural though many birth defects have no known cause. Teratogens are agents believed to cause developmental alterations such as chemicals, infections, and irradiations (Dixon et al., 2011; Knapp et al., 2012). These induce alterations only if exposure takes place at a time when the embryo is sensitive to its effect at a critical stage of intrauterine development.

Birth defect is a widely used term for a congenital malformation, i.e. a congenital, physical anomaly which is recognizable at birth, and which is significant enough to be considered a problem. Apart from the talipes (club foot) deformity, the next common birth defects occur in the maxillofacial region- cleft lip and /or palate.

The optimal time to seek surgical treatment for repair of face defects is before one year of age since the bones are still very soft and easy to work on. However, surgical intervention may be necessary at a much earlier age depending on the severity of

craniofacial deformity (Fig. 7). These days various techniques are available to detect congenital anomalies in foetus before birth and some attempts have also been made to surgically correct a few anomalies in-utero.

Fig. 7. Pre and post- operative teratoma in a neonate.



The most common types of craniofacial anomalies encountered include cleft lip and/or cleft palate, facial clefting, nonsyndromic and syndromic craniofacial syndromes. According to Egbe et al. (2014), non syndromic craniofacial defects account for about 10% of all non syndromic defects. In our environment (Zaria) occurrence of facial defects have been reported by Ajike et al.(2006; 2008) and Ibrahim et al. (2012) (Figs 8).

Fig. 8. Diprosopus (double face)



Source: Ibrahim et al. Nig J Plast Surg **2012**; 8(2): 57-60.

Of these, cleft lip and palate is the most common craniofacial malformations (Eshete et al., 2011) and the causeof several esthetic and functional implications that require rehabilitation (Freitas et al., 2012). The isolated or non-syndromic cleft lip and palate is the most common among the congenital malformations, affecting 1 in every 700 live births (Dixon et al., 2011), even though, there is variation related to the geographic location and socioeconomic conditions (Jia et al., 2009; Slayton et al). Prevalence of cleft lip and or palate is also a variable according to ethnicity, being higher in individuals of Asian descent (1 in every 440 births), followed by Caucasoids (1 in every 650 births) and Blacks (1 in every 2 thousand births) (Freitas et al., 2012). The deformity causes severe aesthetic and functional implications that require rehabilitation **(Fig 9).**

Fig. 9. Cleft lip and palate



Cleft lip may be unilateral or bilateral while cleft palate may be complete, with extension into the nasal cavity, or submucosal,

with a preserved palatal mucosa. Isolated cleft palates may be associated with syndromes such as Pierre-Marie-Robin sequence, Stickler syndrome, Treacher-Collins syndrome, Apert syndrome, 22q11 anomalies, and many others.

Patients usually present with aesthetic defects, difficulty in feeding, breathing and speaking, with occasional middle ear infection (Yi et al., 1999; Rajabian et al., 2000; Sanu and Ajike, 2003). Treatment protocol varies depending on the geographical location but always the treatment is surgical. In this environment it is approximately 3 months of age or the rule of 10s for the lip and between 9 and 12 months for the palate. Subsequently, the patient is followed up in the dental and maxillofacial clinics to correct any dental and maxillofacial discrepancies. In the rare clefts (Fig. 10) a ready protocol is not available.

Fig.10. Rare clefts of the orofacial region.





All patients with facial clefts post operatively have inherent defects in the facial architecture with different morphological characteristics and the involvement of several different types of structures, often impairing the oral cavity, nose and orbit (Fig. 10).

In a three year retrospective study (2008-2010) by Ajike et al. (2013) under the auspices of the smile train organisation, 79 (14.4%) of 550 patients were adult patients with clefts, age range of 17 to 81 years; mean 31.45 ± 13.09. Majority were between 20 and 39 years. There were 54 (68.4%) males and 25 (31.6%) females, with the male: female ratio of 2.2:1. Analysis of the cleft types/site revealed 35 (44.3%) lip alone, 22 (27.8%) lip and alveolus, 7 (8.9%) lip and palate and 15 (19%) palate alone. Seven (8.9%) of the

patients had other relatives with clefts. Sources of information were friends and relatives; 33 (41.8%), radio; 18(22.8%), charity organization/NGO; 13 (16.5%), hospitals/physicians; 5 (6.3%), and others; 10 (12.7%). 57 patients with lip clefts had surgery under local anesthesia while the remaining 22 patients were done under general anesthesia.

All clefts of the lip were repaired using the Millard advancement rotational flap for complete cleft, simple straight line closure for incomplete and double layer closure for the palate.

It was concluded that the incidence of adult patients with orofacial cleft is not rare in our community, probably due to limited access to specialized health care facilities, poverty and ignorance. Furthermore, some of the patients were not aware that their facial defects could be repaired. The advent of the smile train organization and free services has resulted in this harvesting phenomenon.

Cysts of the jaws

A cyst is a pathological cavity having fluids, semifluid or gaseous content which is not created by the accumulation of pus lined by an epithelium (Kramer, 1974; Shear, 1976). Cysts are neither limited to the jaw bones nor to the humans alone; their occurrences in domestic animals and lower primate have been reported. It is the most common cause of swellings of the jaws probably because of the numerous epithelial rest cells found in the jawbones.

The aetiopathogenesis of cysts is complex but could be divided into three parts: epithelial proliferation, cyst enlargement and bone resorption (Toller, 1967; Main 1970; Toller, 1996).

Cysts are more common in the mandible than in the maxilla although some varieties are traditionally localised to the maxillary bone. The maxillary lesions frequently extend to involve the orbital and nasal floors, zygomatic bone/arch, maxillary antrum and the cranial base. They clinically present as insidious growing swelling or occasionally as incidental finding during routine examination. Radiologically, cysts present as well defined radiolucent margins though not diagnostic as other lesions may masquerade as such (Ajike, 1995; Ajike et al., 2004; 2004b; 2007). Aspiration of straw coloured, bright yellow or blood stained fluid is suggestive of a cyst. The main stay of treatment is surgery (Ajike, 1995).

In the analysis by Ajike (1995) of the cystic lesions of the jaws: a prospective analysis of patients seen at the Maxillofacial Unit, ABUTH Kaduna reported 62 cases of which the most common was the cystic ameloblastoma; 41.9% , followed by the dentigerous cyst and the radicular cysts; 21% and 16% respectively (Table 4). The aim of the study was to analyse the serum protein and cholesterol content of cysts.

Table 4. Incidence of coded cysts types in 61 patients.

Cysts types	no of cysts	%
Odontogenic cysts	**11**	**48**
Radicular cyst*	10	16.1
Residual cyst	1	1.6
Odontogenic keratocyst	6	9.7
Dentigerous cyst	13	21.0
Cystic neoplasm	**26**	**41.9**
Ameloblastoma	26	41.9
Non- odontogenic	**5**	**8.1**
Nasoplatine cyst	4	6.5
Nasolabial cyst	1	1.6
Pseudocysts	1	1.6
Haemorrhagic bone cyst	1	1.6
Total	**62**	**100**

*One patient presented with a bilateral radicular cyst.
Source: Ajike. Dissertation for W Afr Coll Surgeons.

There was a predominance of males; 41(67.2%) to 20(32.8%) and a male female ratio of 2.05:1. All the coded cyst types showed a male predominance (Table 5).

The study concluded that young adults are commonly affected with the disease in the age range of 6 to 90 years with an average of 25.95 years (Table 6). The mandible was more involved than the maxilla with an average duration of symptoms of 3 to 15yrs. Aspiration from a cystic fluid though diagnostic but not specific. The color and consistency of the aspirates were highly

variable. The protein content distinguishes between the non-keratinizing and keratinizing cysts. For differential diagnosis of cyst types, the color, consistency of composition of the aspiration must be related to the clinical radiographic and histopathology features.

Table 5. The sex distribution of various cyst types in 61 patients.

Cyst types	Male	Female	Male : Female
Radicular cyst	7	2	3.5:1
Residual cyst	1	-	-
Dentigerous cyst	8	5	1.6:1
Odontogenic keratocyst	4	2	2:1
Ameloblastoma	18	8	2.25:1
Nasopalatine cyst	2	2	1:1
Nasolabial cyst	1	-	-
Haemorhagic bone cyst	-	1	-
Total	**41**	**20**	**2.05:1**

Source: Ajike. Dissertation for W Afr coll Surgeons.

Table 6. Age distribution of 61 patients with respect to various cystic types.

AGE RANGE	ODONTOGENIC					HAEMORHAGIC	
In Years	Radicular	Residual	Dentigerous	Keratocyst	Ameloblastoma	Nasopalatine	Nasolabial	Bone Cyst
0-9				1		1		
10-19	6			8	1	4	1	
20-29	1			4	2	10	2	1
30-39	1			1	2	6	1	1
40-49	1					3		
50-59					1			
60-69						1		
70>						1		

Source: Ajike. Dissertation for W Afr coll Surgeons.

In another retrospective study, Ajike et al., 2007 reported 18 (1.7%) frontal mucoceles (frontal sinus cysts) of 1167 maxillofacial patients seen between 1997 and 2005. There were seven males and 11 females, with a male female ratio of 1:1.6. The age range was from 19 to 65 years with a mean of 41.2 ± 13 and a median of 40.17.

94.4% presented with superonasal swellings; 12(66.7%) with proptosis; 6(33.3%) with diplopia; 12 (66.7%) with epiphoral and 2(11.1%) with loss of vision (Fig. 11).

Fig. 11. Frontocele



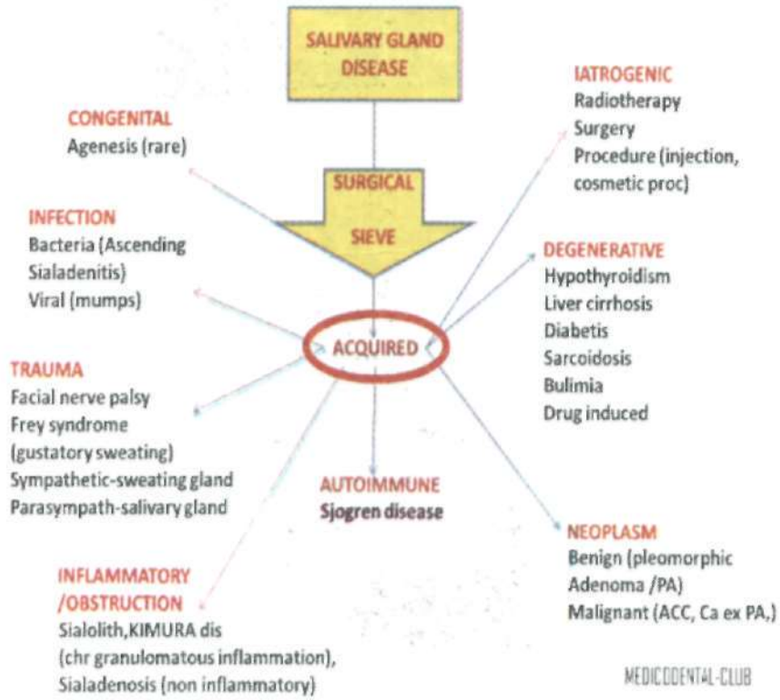
Plain radiograph shows opacification of the frontal sinuses with erosion of the medial walls in in 13(72%) cases. CT scan of 8 patients showed well defined hypodense homogenous frontal sinus and the orbit (Fig. 11). All the eighteen patients had enucleation via a bicoronal approach with frontonasal drain for three weeks for the re-establihment of normal drainage. Contents of the cysts were mucopurulent in 8(44.4%) cases Cheese-like in 6(33.3%) and mucoid in 4(22.2%) cases. Excellent aesthetic results were achieved and no recurrence was observed. The study advocated early

diagnosis and prompt surgical intervention of the lesions, complete surgical extirpation via a bicoronal flap for the grotesque swellings.

Salivary gland diseases

The conditions range from tumours, inflammatory disorders of infectious, granulomatous, or autoimmune etiology to obstructive, developmental, and idiopathic disorders. Fig 12 shows the schematic presentation of salivary gland diseases.

Fig. 12. Schematic representation of salivary gland diseases.



Salivary glands tumours make up 6% of all head and neck tumors and most commonly appear in the sixth decade of life. Most salivary gland tumors arise in the parotid and submandibular glands, and fewer than 10% of tumors arise in the minor salivary glands (Fig. 13). The classification of salivary gland disease in children and adolescents by Ajike and Lakhoo (2009) is shown in table 7.

Table 7. CLASSIFICATION OF SALIVARY GLAND DISEASES IN CHILDREN

1. **Non Neoplastic**
   1. Congenital / developmental
      Agenesis/aplasia/ hypo-genesis./hypoplasia
      Aberrant/ectopic
      Haemangioma
      Lympangioma

   2.Inflammatory and Infection.
   i. Viral

   Acute sialadentis

   -Mumps, CMV, Coxasackie A or B or Parainfluenza virus)

   -HIV associated salivary glands
   ii. Recurrent Parotitis in Children (RPC)

   3. Non-inflammatory
   i. Autoimmune
   Sjogrens syndrome

   4.Cysts:
   i. Ranula
   ii. Mucocele (mucous retention cyst.)

   5. Salivary gland dysfunction
   i. Xerostomia
   ii. Ptyalism/ sialorrhea

2. **Neoplastic tumours**

Salivary gland tumors

A. Benign
   (i) Pleomorphic adenoma
   (ii) Warthins tumour

B. Malignant
   Muco-epidermoid carcinoma
   Acinic cell carcinoma
   adenoid cystic carcinoma

Mesenchymal tumours	
	Neural tissue
	Neurofibroma
	Muscular tissue
	Rhbdomyosarcoma

Source: Ajike and Lakhoo. Paediatric surgery: A comprehensive text for Africa.

Typical features are hard or firm or fluctuant, painless, slow growing, freely mobile, bossellated mass. Facial nerve paralysis and ulceration in association with pleomorphic adenoma never occurs even in large grotesque swellings seen in Africans except in malignant transformation (Fig 14).

Fig. 13. Parotid, Submandibular tumours



Fig 14. Malignant parotid.



The most common intraoral site is the palate, followed by the buccal mucosa and the lip (Fig.15). While in the minor salivary glands, the features include bossellated ulcerated swelling, ill-fitting dentures and difficulty in speech which may occasionally erode the palatine bone, ulceration is usually as result of trauma or following topical application of herbal medication (Ajike et al., 2003).

Fig 15. Palatal pleomorphic adenoma pre and post-op.



Salivary gland tumours in children have the same clinical and biologic behaviour as in adults. A detailed clinical history with imaging features will narrow the differential diagnosis while providing useful information for management and prognosis. Incisional biopsy must be avoided because of tumour spillage and facial nerve damage. (Ajike and Lakhoo, 2009)

Diagnosis is made through fine-needle aspiration biopsy, and the primary treatment is surgical. The treatment of salivary gland diseases is categorized into two: medical and surgical depending on the nature of the disease condition. The neoplastic lesions usually require surgical intervention with or without radiation and chemotherapy, while the non neoplastic/ inflammatory diseases are managed symptomatically and conservatively (Ajike and Lakhoo, 2009).

In 2003, Ajike et al. reported 67 cases of minor salivary gland tumours with the objective of determining the clinical presentation and management of minor salivary gland tumours seen at the Ahmadu Bello University Teaching Hospital Kaduna, Nigeria during a 15-year period. *There were 35(52.2%) benign and 32(47.8%) malignant tumours (Table 8).* Of the 35 patients with benign tumours 32(91.4%) were pleomorphic adenoma while the remaining 3 were monomorphic adenoma. There was no apparent sex predilection with a male (34) and female 33, a ratio of 1.03 to 1. The most common site was the palate (n= 51, 76.1%). 70.15% were in the 3rd to 5th decades of life. The overall duration ranged from 2 weeks to 192 months (mean; 13.6 months, median; 12 months). The signs and symptoms varied from slow growing swelling, nodular,

smooth, soft fluctuant fixed or mobile with ulceration and bleeding (Table 9). 44 cases (81.82%) had surgical treatment while the remaining 11 patients had radiotherapy and one had radiotherapy and chemotherapy. Follow up period was from 1 to 15 years with an overall recurrence rate of 4.48%. This study concluded that minor salivary gland tumours are rare. The outcome of surgery was dependent on the surgical philosophy of wide circumscribing excisions of about 3-5mm margin.

Table 8. Histopathologic classification of 67 minor salivary gland tumors

Classification	No (%)
Benign Tumors	35
Pleomorphic adenoma	32(47.8)
Monomorphic adenoma	3(4.5)
Malignant Tumors	32
Adenoid cystic carcinoma	19(28.4)
Adenocarcinoma	8(12)
Muco-epidermoid carcinoma	4(6)
Malignant pleomorphic adenoma	1(1.5)
Total	*67(100)*

Source: Ajike et al. Nig J Surg Research 2003; 5: 100-105.

Table 9. Signs and symptoms of 67 minor salivary gland tumors.

Signs	Benign		Malignant		
	Pleomorphic adenoma	Monomorphic adenoma	Mucoepidermoid tumor	Adeno-carcinoma	Adenoid cystic carcinoma	Malignant pleomorphic
Painless swelling	23	1		2		
Painful swelling	3	2		15	6	
Slow swelling	25	3	2	2	1	
Rapid growing	-	-	1	8	3	1
Smooth	6	1	2	-	1	-
Nodular	9	-	-	1	1	-
Soft	9	-	-	5	-	-
Firm	21	3	-	5	5	-
Fluctuant cystic	6	-	-	2	-	-
Fixed	-	1	2	3	4	1
Mobile	3	-	1	-	1	-
Ulceration	6	-	3	13	6	1
Bleeding	1	-	-	5	4	1
Metastatic	-	-	-	4	2	-

NB. A single case often had multiple signs and symptoms and not all the features were recorded for each tumour.

Source: Ajike et al. Nig J Surg Research 2003; 5: 100-105.

The summary of this was that minor salivary gland tumours are rare. Late presentation was the reason for the large swellings and ulcerations. The modalities of treatment were surgery ± chemoradiation and for low recurrence radical surgery is advocated.

Maxillofacial trauma

This constitutes a high percentage of all daily traumatic admissions in the surgical wards (Thaller and Beal, 1991) and form the bulk of the surgical procedures in some maxillofacial centres. The mid face is divided into upper and lower parts. The upper mid face is made up by the zygoma, nasal bones, ethmoid bone, and non-tooth–bearing segment of the maxillary bone which is where maxillary LeFort II and LeFort III fractures occur and/or where fractures of the nasal bones, nasoethmoidal complex (NOE) or zygomaticomaxillary complex (ZMC), and the orbital floor occur and The lower midface is composed of the maxillary alveolus, teeth, and the palate and is where LeFort I fractures occur (Fasola et al., 2003; Owoeye et al., 2013) (Fig 16). The lower face is composed of the mandible where fractures can occur (Anyanechi et al., 2011)

Fig 16. Naso-ethmoido-fronto-orbital fracture.



Injuries to the face, by their very nature, impart a high degree of emotional and physical trauma on patients. Typically, facial injuries are classified as either soft tissue injuries (skin and gums) (laceration), bony injuries (fractures) (Fig. 17) (Fasola et al., 2000; Abbas et al., 2013), or injuries to special regions (such as the eyes, facial nerves or the salivary glands) (Kamath et al., 2012; Ajike et

al., 2011). More than 50% of patients with such injuries have multisystem trauma that requires coordinated management between emergency physicians and surgical specialists in oral and maxillofacial surgery, otolaryngology, plastic surgery, ophthalmology, and trauma surgery (Ajike et al., 2005). Age ranges mostly between 21and 30 years, with a male preponderance (Gandhi et al., 2011).

Fig. 17. Soft and hard tissue injuries.



Majority occur in the mandible (Bali et al., 2013). The aetiology of maxillofacial injuries varies from country to country, even regionally and is influenced by social, cultural, seasonal and environmental factors (Ugboko et al., 2002a; Fasola et al., 2003; Kruger et al, 2006). The main causes of injury were road traffic accidents and interpersonal violence (Ajike et al., 2005; Anyanechi et al., 2011) with involvement of two-wheeled vehicles (Oginni et al. 2009). In socio-economically advanced countries, drugs and alcohol are often associated with interpersonal violence in causing facial injuries.

In an ascending order the clinical presentation of LeFort I fractures include facial edema and mobility of the hard palate and maxillary alveolus and teeth, LeFort II fractures include facial edema, telecanthus, subconjunctival hemorrhage, mobility of the maxilla at the nasofrontal suture, epistaxis, and possible CSF rhinorrhea while LeFort III fractures include massive edema with facial rounding/ballooning, elongation, and flattening (Fig 18).

Fig 18. Fracture of the maxillofacial skeleton.



An anterior open bite may be present due to posterior and inferior displacement of the midfacial skeleton. Movement of all facial bones in relation to the cranial base with manipulation of the teeth and hard palate, epistaxis, and CSF rhinorrhea may also be found upon physical examination (fig. 18).

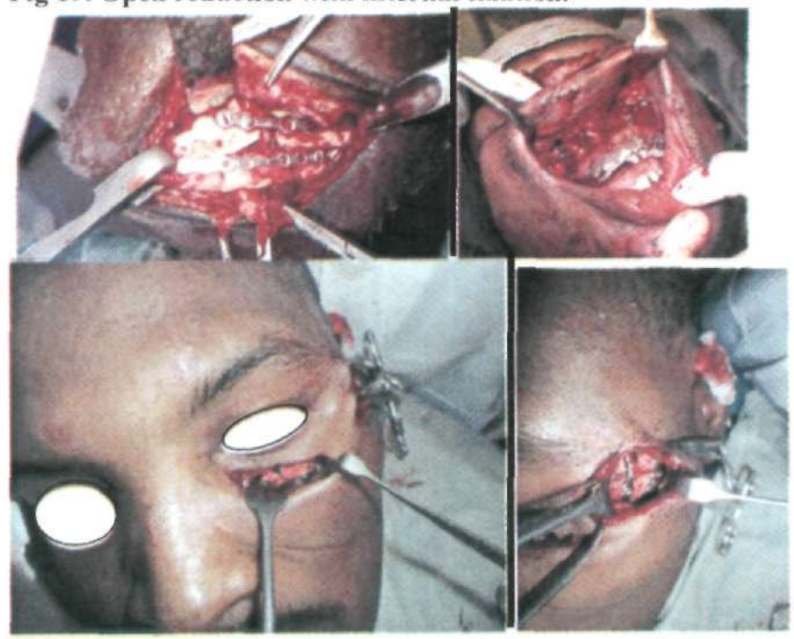
Common findings of mandibular fractures include painful jaw movement and malocclusion of the teeth and an inability to open the mouth or bite down hard. Mobility and crepitus can be palpated along the symphysis, angles, or body.

Intraoral edema, ecchymosis, gingival bleeding, or tears may be present. An anterior open bite can occur with bilateral condylar or angle fractures. Disruption of the inferior alveolar nerve, including the mental branch, may cause paresthesia or anesthesia of half of the lower lip, chin, teeth and gingiva when the fracture involves the mandibular angle, body, or parasymphysis.

Condylar fractures are the most often overlooked. The area anterior to the meatus of the ear is tender to palpation. The condyle on the fractured side does not move when the mandible is opened and closed.

The main stay of treatment of maxillofacial fractures is reduction and immobilization which could be achieved either by close or open reduction and internal fixation (Fig 19).

Fig 19. Open reduction with internal fixation.



The relatively recent development and use of "rigid fixation" has profoundly improved the recovery period for many patients, allowing them to return to normal function more quickly.

Complications may include aspiration, airway compromise, scars, permanent facial deformity secondary to improper treatment nerve damage resulting in loss of sensation, facial movement, smell, taste, or vision, infection, malnutrition, weight loss, nonunion or malunion of fractures, malocclusion, hemorrhage.

In 2005, my colleagues and I in an epidemiological survey of maxillofacial fractures and concomitant injuries in Kaduna, Nigeria reported 820 fractures of the maxillofacial skeleton and 70 concomitant injuries from 543 patients. Road traffic crashes (50.8%) were the most common aetiologic factor followed by falls (20.3%) and fights (18.8%). The age range was from 3.5 years to 67 years (mean =39.7) and a peak incidence in the 4th decade (n=197, 36.3%) with a male –female ratio of 3.7:1 (Table 10). The most common location was the mandible 615 (75%) and middle third 205(25%) (Table 11).

Table 10. Age and sex distribution of maxillofacial fractures.

Age	Sex		Total(%)
	Male	Female	
0-10	9	4	13(2.4)
11-20	45	17	62(11.4)
21-30	123	25	148(27.3)
31-40	157	40	197(36.3)
41-50	64	22	86(5.8)
51-60	19	4	23(4.2)
61-70	11	3	14(2.6)
Total	**428**	**115**	**543(100)**

Source: Ajike eta al. Nig J Surg Research **2005**:7: 3-4.

There were 316 (58.2%) isolated mandibular fractures, 124(22.8%) isolated middle third fractures and 65 (12%) combined mandibular and middle third fractures. Majority of the patients were treated by closed reduction. Concomitant injuries were 8.5% with orthopaedic injuries accounting for the majority (67.1%) (Table 12). The study concluded that maxillofacial injuries were on the increase and advocated for the establishment of regionalized trauma centres. To reduce the number of injuries, there is need for better road safety laws with stringent enforcement particularly for those between 15 and 45 years of age who should be educated about road safety laws.

Table 11. Anatomic distribution of maxillofacial fractures.

Location	No of fractures (%)
Mandible	
Symphysis	56(9.1)
Body	164(26.7)
Angle	145(23.6)
Condyle	40(6.5)
Ramus	121(19.6)
Dento-alveolar	89(14.5)
Total	**615(100)**

Types	
Unilateral	380(61.8)
Bilateral	137(22.3)
Multiple	98(15.9)
Total	**615(100)**

Mid face	
Dento-alveolar	11(5.4)
Lefort I	22(10.70)
Lefort II	54(26.3)
Lefort III	8(3.9)
Zygomatic	86(42.0)
Fronto-naso-ethmodial	18(8.7)
Palatal split	6(3.0)
Total	**205(100)**

Source: Ajike et al. Nig J Surg Research **2005**:7: 3-4.

Table 12. Concomitant injuries with maxillofacial fractures.

Type of injury	**No of patients (%)**
Cranio-Cerebral	11(15.7)
Orthopaedic limb fracture	41(58.5)
Pelvic fracture	4(5.7)
Clavicular fracture	2(2.9)
Pulmonary injury	6(8.6)
Ocular Injury	4(5.7)
Abdominal injury	4(5.7)
Total	**70(100)**

NB. One patient had more than one injury

Source: Ajike et al. Nig J Surg Research **2005**:7: 3-4.

The study shows that the fractures of the facial skeleton is not restricted to any age or sex in the young adult males between age 30 and 40 years. Any facial bone can be fractured but in our

environment, mandibular fractures are predominant with RTA as the main cause. The high frequency of maxillofacial fractures due to RTA in our population highlights the need for environment regulations and the wearing of safety helmets by motorcyclists. Also there is the need for repair of bad roads and the resuscitation of the rail transport system as an alternative to road transport for man and goods. In view of the avoidable morbidity and mortality due to inadequate treatment, we advocated the establishment of regionalized, efficient and focused trauma centers in various parts of the country particularly for acute trauma.

Neoplasm of the jaws

A neoplasm is an abnormal growth of tissue, the growth of which exceeds and is uncoordinated with that of the normal tissues and persists in the same excessive manner after ceasation of the stimuli which evoked the change (Willis, 1952). Neoplasms of the jaws constitute the bulk of the work of the oral and maxillofacial surgeon. The aetiology of such tumours includes poor oral hygiene (Ajagbe and Daramola, 1978), viruses (especially Epstein Barr) (Lamey et al., 1982; Goldstein and Berstein, 1990; Otoh et al., 2009; Paquette et al., 2013), trauma and irritation (Foresberg, 1954; Shafer et al., 1983), alcohol (Oshodin, 1981) and congenital (Lucas, 1984). Classifications of the jaw tumors are cumbersome and complex because of the varied tissues in the maxillofacial region. Many classifications (Pindborg and Clausen, 1958; Lucas, 1984; WHO, 2005; Bhasker, 1963) exist in the literature, however, authors agree that they could be divided into two main groups: the odontogenic (tumours originating from tooth bearing tissues or their remnants) and the non odontogenic (tumours arising from other tissues in the orofacial region) tumours (Rafindadi and Ayuba, 2002; Arotiba et al., 2003). The incidence of tumours of the jaws varies widely from geographic locations and in different studies. For instance, the western literature favour carcinomas as the most common tumor and odontomas as the most common odntogenic tumour followed by ameloblastoma and the myxomas (Ochsenius et al., 2002; Ramous et al, 2014), whereas the Nigerian and Asian literatures favoured the amelobalstoma followed by myxoma, adenomatoid odontogenic tumours, (Lu et al.1998; Adebayo et al., 2002; 2005; Arotiba et al.,

2007), even though odontomes are rare in this environment (Ajike and Adekeye, 2000).

Symptoms of jaw neoplasm are swelling, pain, tenderness, and unexplained tooth mobility with extensions into contiguous structures. Some tumors are discovered on routine dental x-rays, whereas others are found on routine examinations of the oral cavity and teeth Ajike et al. (2000b; 2009).

Treatment depends on location and tumor type. Benign tumors may be observed and may not need surgical excision, although most tumors require resection with possible reconstruction (Adebayo et al. 2005; Arotiba et al., 2005).

In a retrospective analysis from Kano, Nigeria by my colleagues and I (Arotiba et al., 2003) there were 55 cases of orofacial tumours and tumour-like lesions of the jaws. Table 13. shows the histologic types and sex distribution of orofacial tuomors and tumour-like lesions.

Table 13: Histologic types and sex distribution of orofacial tumours and tumour-like lesions (Arotiba et al. 2003)

Histological type	Sex		Total
	Male	Female	
Odontogenic			
Benign			
Ameloblastoma	5	4	9
Fibromyxoma	1	0	1
Cem. Fibroma	0	1	1
Odontome	0	1	1
Malignant			
Ameloblastic carcinoma	1	0	1
Non-odontogenic			
Benign			
Osteoma	1	0	1
Central giant cell granuloma	0	1	1
Fibroma	0	1	1
Lipoma	0	1	1
Peripheral giant cell granuloma	0	2	2
Pyogenic granuloma	1	1	2
Haemangioma	1	3	4
Neurofibroma	1	0	1
Pigmented naevus	1	0	1
Fibrous dysplasia	1	0	1

Salivary gland			
Pleomorhic adenoma	2	0	2
Malignant			
Osteosarcoma	1	2	3
Burkitt's lymphoma	1	1	2
Dermatofibrosarcoma	1	0	1
Squamous cell carcinoma	8	4	12
adenosquamous cell carcinoma	1	0	1
malignant melanoma	1	0	1
basal cell carcinaoma	0	1	1
Salivary gland			
Mucoepidermoid carcinoma	1	2	3
Adenocystic carcinoma	1	1	2
Total	29 (52.7%)	26(47.3%)	55

Source: Arotiba et al. Nig J Surg Research 2003:5:134 – 139.

Three most common odontogenic tumours: ameloblastoma, myxoma and adenomatoid odontogenic tumour and the rare odontomes were reported by this lecturer (Ajike and Adekeye, 2000; Ajike et al., 2000a; 2002b; 2009). A closer look at the most common epithelial odontogenic tumour in our environment by Ajike et al. (2009) showed 350 cases of ameloblastoma seen between January 1997 and April 2007, a 10 year period from which there were only 21 (6%) cases in the maxilla.

Analysis of the maxillary ameloblastoma reported 13 (57.1%) males and 8 (42.9%) females; with a male female ratio of 1.6 to 1. The age at diagnosis ranged from 17 to 55 years (mean =38.14), majority 13 (66.4%) were in the 4th and 5th decades of life (Table 14). Duration of lesion ranged between 3months and 14 years (mean =4.3, median=3).

Table 14: Age and sex distribution of 21 patients with maxillary ameloblastoma

Age range	Sex		No(%)
	Male	Female	
0-9			
10-19	1	1	2(9.5)
20-29	3		3(14.3)
30-39	3	2	5(28.3)
40-49	7	1	8(38.1)
50-59	2	1	3(14.3)
TOTAL	**13**	**8**	**21(100)**

Source: Ajike et al. Nig Med J 2009; 50(2):47-51.

There were 18 (85.7%) unilateral and 3 (14.3%) bilateral cases, while 20 (95.2%) were posterior tumours and one (4.8%) anterior tumour. Three of the posterior tumours had crossed the midline (Fig. 20).

Fig20. Maxillary ameloblastoma crossing the midline



The clinical presentations varied greatly, but all the 21 cases had grotesque swellings (Fig 21). In terms of site, majority, 19 (90.5%) had antral involvement with two (9.5%) extending into the zygomatic bone, the temporal region and into the orbit with blindness respectively (Fig. 21).

Fig. 21. Ameloblastoma involving the maxilla, zygomatic bone and the temporal region.



There were involvements of nasal cavity in five (23.8%) and one (4.8%) case in the palate. Presenting complaints were teeth mobility in 12 (57.1%) cases, exfoliated teeth in 7 (33.3%), nasal swelling/obstruction in 5 (23.8%), ulceration of lesion in 9 (42.9),

proptosis in 3 (14.3%), occlusal furrow in 10 (47.6%), bleeding in 4 (19.0%) and epiphora in one (4.8%) case.

The histopathologic types and their gross/ biologic appearance are presented in table 15. Radiography showed multilocular radiolucency and opacification of the maxillary sinus in 20 (95.2%) and one (4.8%) unilocular radioluency. Radical treatment was the modality of treatment in 20 (95.2%) and one (4.8%) had enucleation (Table 16). There were two (18.2%) recurrences of 11 followed up cases and (9.5%) of total cases. All the patients had radical maxillary procedures table 20

Table 15: The histologic types and their gross appearance

Histopathologic types	**No**	**%**
Follicular	11	52.4
Follicular with squamous metaplasia	3	14.3
Plexiform	3	14.3
Acanthomatous	4	19.0
Total	21	100
Gross appearance		
Solid	18	85.7
Cystic	1	21
Solid-cystic	2	9.5
Total	21	100

Source: Ajike et al. Nig Med J 2009; 50(2):47-51.

Table 16: Treatment modalities of 21 patients

Treatment modalities	**No**
Total maxillectomy**	15
Bilateral maxillectomy	2
Palatoal vecolectomy	1
Subtotal maxillectomy**	2
Radical maxillectomy + excision of zygoma	1
Enucleation	1
Total	**22**

**1 patient had left total maxillectomy with right subtotal. *2 patients had orbital exenteration.
Source: Ajike et al. Nig Med J 2009; 50(2): 47-51.

The defects were reconstructed in 9 cases using acrylic obturators with satisfactory results. Follow-up up period of 8 of the patients was from 6months to 2 years with 1(7.1%) recurrence.

The study concluded that maxillary ameloblastoma is uncommon. The richly vascularised and cancellous maxillary bone facilitating extension into paranasal sinuses, orbital and cranial cavities make maxillary ameloblastoma very lethal. Radical surgery offers the best result, while rehabilitation postoperatively remains a challenge particularly in bilateral maxillectomized patients (Fig. 22). A lifelong time follow-up is advocated.

Fig 22: Bilateral maxillectomized patient.



Source: Ajike et al. Nig Med J 2009; 50(2): 47-51.

Regarding the myxoma, which is the second most common odontogenic tumour and most common mesenchymal tumour in our environment, my colleagues and I (2000a) analysed 27 cases representing 8.5% of all (318) odontogenic tumours seen from 1985 to 1995. There was a female preponderance, a female to male ratio of 2.4:1 with an age range of 11-77 years (mean 29.6) with peak in the 4th decade of life. The mean age for the females was 31.3 years and 25.8 years for the males. Presentations were with slow growing painless swellings of which 26 cases were firm in consistency with overlying pale mucosa while there was ulceration in one case. Duration of symptoms ranged from two months to 14 years (mean 2.3years). The average duration for males and females were 1.8 and 2.6 respectively. Ocular symptoms were blindness and proptosis, with extension into the ethmoidal sinuses in one case. Features related to teeth included; toothache (26), loosening (5), displacement (14) and exfoliation (13). There were 14 (52%) mandibular and 13

(48 %) maxillary tumours. Majority were in the premolar and molar regions (Table 17).

Table 17: Site distribution of 27 cases of myxoma of the jaws.

Site of myxoma	No (%)
Mandible	
Horizontal ramus(anterior segment)	1 (3.7)
Horizontal ramus (posterior segment)	7 (25.9)
Horizontal ramus (antereior & posterior segment)	3 (11.1)
Horizontal ramus (anterior & posterior segments) and the vertical ramus	1 (3.7)
Horizontal (posterior segment) and vertical ramus	2 (7.4)
Maxilla	
Anterior maxilla	2 (7.4)
Posterior maxilla	4(14.8)
Posterior maxilla and tuberosity	3 (11.1)
Anterior and posterior maxilla and tuberosity	2(7.4)
Posterior maxilla, zygoma and antrum	1(3.7)
Anterior and posterior maxilla, zygoma, antrum, ethmoid and nose	1(3.7%)
Total	**27(100)**

Source: Ajike et al. Nig J Surg Research 2000; 2(3-4): 123-125.

Of the 18 cases (10 mandibular and 8 maxillary) with available radiographs majority (63%) were multilocular radiolucency; 2 soap bubble, 2 tennis racket, 1 honey comb while the remaining five were simply described as multilocular. For the maxillary lesions six of the eight were radiopaque while the remaining 2 (premaxillary lesions were multilocular). 26 (96%) of the 27 patients had surgical intervention (Table 18).

Table 18: Surgical intervention for 26 myxoma of the jaw bones

Surgery	no (%)
Curettage	3
Excision (0.5mm from apparent normal bone)	9
Resection (1 cm of apparent normal bone margin)	5
Resection with disarticulation (2 hemi mandibulectomies and one subtotal mandibulectomy)	3
Excision of tumour with dento-alveolar segment and preservation of the lower border of the mandible	4
Maxillectomy	2
Total	**26(100)**

Source: Source: Ajike et al. Nig J Surg Research 2000; 2(3-4): 123-125.

Follow-up of the 26 cases for 13 years (mean 5 years) with a recurrent tumour (3.7%) of total cases and (3.8%) of operated cases 3 years postoperatively.

This study alluded to the rare nature of jaw myxoma and enucleation should be avoided. However, curettage with scarification of the cavity with acrylic bur may be used for small lesions in the anterior mandible especially where patient is educated and follow-up reviews are possible. Finally, a radical approach as seen in the study is more appropriate with regular follow-up.

Report of nine cases of adenomatoid odontogenic tumour, representing 2.8% of 318 odontogenic tumours during a 20-year period (1979-1989) by Ajike et al. (2000b) concurs with the rarity of this tumour in our environment. Table 19 demonstrates the summary of the nine cases seen.

Table 19: Summary of the nine cases of Adenomatoid *odontogenic tumors* seen at ABUTH, Kaduna, Nigeria, 1979-1998

Case No.	Age	Sex	Duration	Site	involved tooth	Radiological features	Clinical diagnosis	Treatment	Follow up
1	15	F	6 months	maxilla 123	5	unilocular radiolucency	Dentigerous cyst	Enucleation	6 years
2	1	F	3 months	maxilla (ant)	7	unilocular radiolucency	N/S	Enucleation	13 years
3	12	M	months	maxilla 2-6	3	unilocular radiolucency	AOT	Enucleation	6 months
4	38	M	3 months	mandible 4-1	3	mixed unilocular radiolucency	Fibro- osseous lesion	Excision	9 years
5	19	M	6 months	maxilla 1-5	4	unilocular radiolucency	Dentigerous cyst	Enucleation	10 years
6	15	F	6 months	maxilla 3-1	2	unilocular radiolucency	AOT	Enucleation	-
7	23	F	2 months	mandible 5-3	4	unilocular radiolucency dentigerous	Unicystic Ameloblastoma cyst	Resection	-
8	12	M	6 months	maxilla 4-8	5	unilocular radiolucency	Dentigerous cyst	Enucleation	3 years
9	7	M	9 months	maxilla	3	unilocular	AOT	Enucleation	6 years

Source: Ajike et al. W Afri J Otolaryngol. Head Neck Surg 2000; 3: 40-43.

A *case reported of an odontoma* by Ajike and Adekeye (2000) also attest to the rarity of the tumour entity in our environment.

Primary malignant tumours of the oral and maxillofacial region could be tumors of epithelial origin (carcinoma) , immune system, and tumors of mesenchymal origin (sarcoma) (Azadeh et al.,2008; Subhashraj et al., 2009), however, the most common are the carcinomas, sarcomas, and the lymphomas (Adebayo et al., 2005; Ajayi et al.,2007; Otoh et al., 200). Of these epithelial malignancies, squamous cell carcinomas (Fig. 23) are the most common, followed by mucoepidermoid and the adenoid cystic carcinoma (Lawoyin et al., 1997; Otoh et al. 2005). Predisposing factors include poor diet and oral hygiene, smoking, alcohol, kola nuts (Otoh et al 2005; Chidzonga 2006; Chitapanarux et al.2006).

Fig 23: Squamous cell carcinoma stage IV



It is a disease of the middle aged and above (Chidzonga, 2006; Azadeh et al., 2008), however, most recent reports now favour occurrence in younger populations (Llewellyn, 2001; Chitapanarux et al., 2006; O'Regan et al., 2006). However, O'Regan (2006) speculated that it is possible that the biology of squamous cell carcinoma of the head and neck in young people differs from that in older people, whereas Llewllyn et al. (2001) proposed a predisposition to genetic instability as a likely cause.

Majority of the patients present with the late stage (III and IV) (Ugboko et al. 2004; Otoh et al., 2005; Ribeiro et al., 2009) (Fig. 23). Carcinomas are more common in males than females (Chidzonga 2006; Azadeh et al., 2008; Ribeiro et al., 2009). Regarding the sites, maxillary antrum is the most common extra orally (Ugboko et al., 2004) while intraorally, the tongue is the most common site followed by the major salivary glands (Chidzongaet al, 2006; Azadeh et al., 2008). The treatment of oral and maxillofacial

carcinomas is surgery with or without chemotherapy and radiotherapy (Ugboko et al., 2004; Chitapanarux et al., 2006).

Socio economic status (SES) of oral and maxillofacial patients

Several reports have recorded a strong association between oral and maxillofacial diseases and the socio-economic status of patients (Adekeye and Ord RA, 1982; Hodbell et al., 2003; Olasoji et al, 2005; Omisakin et al., 2013). According to Hodbell et al. (2003), one of the puzzles of public health is why some populations are healthier than others. The socioeconomic factors (ignorance, illiteracy and poverty) of patients have a great influence on the survival and outcome of the maxillofacial surgical patients particularly the oral malignancies and cervicofacial infections (Agarwal et al., 2007).

It is very difficult to establish the economic status of Nigerians as they always believe it is none of your business. However, my colleagues and I were able to determine the social status (Table 20) of the patients in two separate studies (Ajike et al., 2004; Omisakin et al., 2013) according to the index of Oyedeji et al. of 1984.

Table 20: Socio economic status of oral and maxillofacial patients

Occupation	no	%
Professionals (Lawyers, doctors, engineers etc)	4	4.6
Artisans(barbers, tailors, mechanics, hairdressers, etc)	5	5.7
Trading	18	20.7
Small scale businessman	7	8.0
Teaching	3	3.4
Farming	11	12.6
Civil servants	101	1.5
Students	131	4.9
Labourers/ messangers/cooks	2	2.3
Drivers	6	6.9
Unemployed/housewife	8	9.2
Total	87	100

Source: Ajike et al. West Indian Med J

Many Nigerian studies (Lasisi et al., 2002; Olasoji et al., 2005; Omisakin et al., 2013) and this study agree that majority of the maxillofacial patients attending tertiary institutions were in the lower and intermediate socio-economic group. In actual fact cancrum oris is found mainly in the lower socioeconomic group (Adekeye and Ord, 1983). The socio-economic index of patients has a direct relationship with the disease and the outcome. From the Kano study (2004), only 2 of the 87 patients had reconstruction of the mandible following its ablation with iliac crest bone graft and Steinmann's pin. The two patients were in the high socioeconomic group.

Cervico facial abscesses and infections (multi- space infection)

For centuries, the diagnosis and treatment of cervico-oro facial infections have challenged physicians and surgeons. The complexity and the deep location of this region make diagnosis and treatment of infections in the area difficult. These infections remain an important health problem with significant risks of morbidity and mortality (Pourdanesh et al., 2013). Infection of the region may be due to bacterial, fungal or viral (Ugboko et al., 2002; Amanyeiwe-Adaka et al. 2004; Owotade et al., 2005). However, the most common are bacterial infections (Ndukwe et al., 2007).

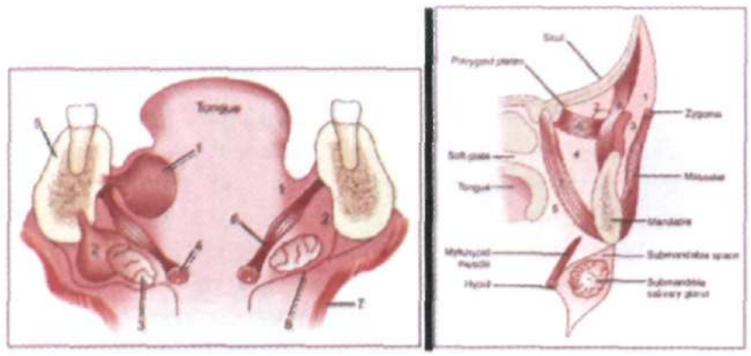
Orofacial infections may be odontogenic or non odontogenic in nature and majority of odontogenic infections are caused by the endogenous bacterial microbiota in the oral cavity (Dahlén, 2002) while non odontogenic infections vary depending on the nature and site of infection (Sandor et al., 1998). Today, odontogenic origin is the most common etiology in adults whereas tonsillitis remains the most common etiology of deep neck space infections in children (Ndukwe et al., 2007; Chang et al 2010; Conrad et al. 2012). Morbidity and mortality related to such infections depend on the site of involvement and the degree of spread to other tissues (Fig 24 and 25).

The age group is usually between 21 and 40 years (Kudiyirickal and Hollinshead, 2012) with no sex predilection (Gonçalves et al., 2013), although Akinbami et al. (2010), documental more males.

Most of the odontogenic infections originate from the mandibular region (Pourdanesh et al., 2013).

Pathophysiology of odontogenic infection: invasion of the dental pulp by bacterial, infection following dental caries of a tooth →Inflammation, edema and lack of collateral blood supply→ venous congestion or a vascular necrosis consequently leading to death of the pulp → reservoir for bacterial growth → the bacteria penetrate and spreading into the surrounding bone (osteomyelitis) and the soft tissues (cellulitis) (Fig25).

Fig 24: Spread of odontogenic infection.



Odontogenic infections are usually polymicrobial consisting of anaerobe, aerobes and mixed organisms(Bratton et al., 2002; Walia et al.,2014) of which the most common bacteria are Staphylococcus aureus, Klebsiella, E. Coli, Peptostreptococcus and the Fusobacteria (Rega et al., 2006; Akinbami et al, 2010).

An aspect of cervico-facial infections is cellulitis. This is inflammation of the connective tissues. It is characterized by brawny, board like diffuse swelling of the tissue spaces. The spaces involved are usually the submandibular, sublingual, submental, masseteric/ submasseteric, canine and infratemporal spaces (Fig. 25).

Fig. 25. Cellulitis involving submandibular, submental, sublingual, canine masseteric/submasseteric, temporal and infratemporal spaces



Diagnosis of cervico-facial infections is based on the patient's history, physical findings, imaging modalities and laboratory results (Bratton et al). However, multi space involvement is very often seen as in Ludwig's angina where the submandibular sublingual and the submental spaces are involved bilaterally (Fig 26).

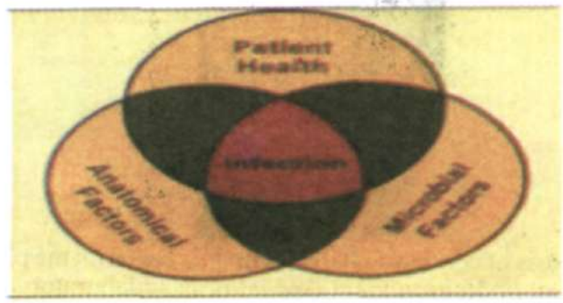
Fig. 26. Ludwig's angina



It presents with diffuse swelling of the floor, protrusion of the tongue, difficulty in speech and breathing with trismus. Usually there is no pitting or induration. Patients appear toxic with systemic malaise and pyrexia. This type of cellulitis carries a high risk of morbidity and mortalilty (Gonclaves et al., 2013; Pourdanesh et al., 2013). The risk factors in cervico facial infections are: host factors (age above 45, presence of underlining diseases, immunity,

malnutrition, habits; smoking and drinking, dehydration), microganism and anatomical barriers. The interplay is shown in fig 27.

Fig 27. Interplay of host, anatomical and microbial factors in cervicofacial infection



In order to manage such infections scientifically, correct identification of the aetiology and pathology of the disease is important. Appropriate choice and duration of antimicrobial prescription for the infections rely upon the age, systemic infection and other co-morbidities of patients. Analysis of etiopathogenesis and presentations of orofacial infections, in a general dental practice would help to understand the clinical spectrum of such important illnesses and tailor the right treatment strategy for patients in future.

Basic treatment includes appropriate medication (sensitive antibiotics usually penicillins and flagyl), and surgical therapy (incision and drainage) (Bratton et al 2002; Rega et al., 2006; Goncalves et al., 2013). Multi space infections are usually drained extraorally. Establishment of airway before initiating any surgical procedure may be necessary in some forms of cellulites, particularly in Ludwig's angina.

Complications of cellulitis include Necrotizing fasciatis (flesh eating bacteria), mediastinitis, pleural effusion, Ludwig's angina, cavernous sinus thrombosis, osteomyelitis, cancrum oris (Fig. 28).

Fig. 28. Necrotizing fasciitis as a complication of cellulitis.



Disease of the temporo mandibular joints

The temporomandibular joint is a craniomandibular joint formed by the condylar process of the mandible and the glenoid fossa of the squamous temporal bone. It is a ginglymoarthroidal joint i.e. it has both hinge and sliding actions (Kapoor, 2011). The joint may be affected by a plethora of diseases: dislocation (Olaitan et al., 2001; Ugboko et al., 2005), congenital anomalies (Ajike et al., 2006; 2008), trauma (Ajike et al.,2011a), temporomandibular joint dysfunction/disorder (Wang et al, 2012), ankylosis (Ajike et al., 2005; 2011b; Bello et al., 2012), degenerative diseases (Wang et al., 2012) and occasionally by tumours and pseudotumours (Nwoku and Koch, 1974). Of these diseases, the most commonly encountered in our environment is the temporomandibular joint ankylosis which was analysed by Ajike and Omisakin in 2011 which included, 26 patients: 12 males and 14 females a ratio of 1.6:1 (Table 21) with 19 unilateral and seven bilateral joints giving a total of 33 joints ankylosis (Table 22) seen during a nine year period from January 2000 to December 2008..

Table 21: Aetiology and sex distribution of 26 patients with temporomandibular joint ankylosis

Aetiology	No (%)	Gender	
		Male	Female
Trauma	18(69.2)	10	8
Infection			
Otis media	2(7.7)		2
Cancrum oris	3.(11.5)	1	2
Unknown	2(7.7)	2	
Congential	1(3.9)	1	
Total	26(100)	12	14

Source: Ajike et al. West Indian Med J 2011; 60(2): 172-176.

Table 22: Features associated with temporomandibular joint ankylosis

Side of ankylosis	*No of patients*	*%*
Left	7	26.9
Right	12	46.2
Bilateral	7	26.9
Total	**26**	**100.0**
Type of ankylosis		
Bony	23	69.7
Fibro-osseous	8	24.2
Fibrous	2	6.1
Total	**33**	**100.0**
Stage of bony/fibrous-osseous ankylosis		
Ankylotic bone limited to condyle	16	51.6
Ankylotic bone extending to Sigmoid notch	3	9.7
Ankylotic bone extending to the Coronoid process And part of the arch	10	32.2
Ankylosis involving the maxilla and mandibular bones	2	6.5
Total	**31**	**100.0**

Source: Ajike et al. West Indian Med J 2011; 60(2): 172-176.

Anaesthesia was a great challenge, the mode of aesthesia of 25 patients were tracheostomy, blind nasal intubation and fibreoptic laryngoscopy. Treatment modality was surgery (Table 23). Gap arthroplasty was done in 20 joints while the remaining 11 joints had interposition arthroplasty. Interposition materials used were 7 pterygomasseteric slings, 3 auricular cartialage and 1 skin. Post–operatively: there 7 anterior open bites, 3 facial nerve weaknesses, 3 infections with 2 recurrences.

Table 23: Surgical procedures on 31 joints

Surgical procedure	Number
Bilateral condylectomy	4
Condylectomy +angle ostectomy	8
Condylectomy	4
Condylectomy + excision of bone in the sigmoid notch	3
Angle osectomy	10
Body osectomy +excision of fibrous band	2
Total	**31**

Source Ajike et al. West Indian Med J 2011; 60(2): 172-176.

I must quickly add here that, although quite a number of dislocations of the temporomandibular joint dislocations probably occur without their reports to the hospital because majority of them are acute and as such are easily reducible by the patients. However, the chronic types of dislocations are the ones often seen. This lecturer and his colleagues have documented similar cases (Olaitan et al., 2001; Ugboko et al., 2005) encountered in this geographic location.

Reconstruction

Surgical ablation of the jaws results in high morbidity with significant psychological and functional implications, some of which include difficulties in mastication, deglutition, speech and poor facial aesthesis. The resultant facial disfigurement may cause severe debilitating effects in the patients thus preventing normal societal social interaction which may be challenging to the oral and maxillofacial surgeon (Fig. 22).

Surgical reconstruction of maxillofacial defects require the provision of skin coverage (Fig. 29), establishment of the continuity of the face/jaws through bone grafts (Fig. 30) or alloplastic materials (Osunde et al., 20013), creation of buccal and lingual sulcus to provide a stable foundation for the in-coming prosthesis (Fig. 31) Furthermore, pre-prosthetic implants may be needed to improve retention and stability of facial prosthesis. Facial prosthesis may also be made and delivered with frames or occasionally attached with special gums to the area (Fig 32 and 33).

Fig 29: Reconstruction with skin coverage after excision of fibrosarcoma



Fig 30: Frontal facial defect with bone grafting



Fig 31: Mandibular ameloblastoma with full restoration of function, and aesthetics following mandibular reconstruction



Fig 32: Facial/ear prosthesis for part of lost ear.



Fig 33: Orbital prosthesis following traumatic extrusion of the left eye



The future human face

Mr Vice- Chancellor Sir, since I started with a question permit me to end with another question, which is just a pip into the future: How will the future human face look like?

The human face is constantly changing, although, very slowly. In prehistoric times, the face was more like that of an ape. The shape has also changed in present time to what it is now. What significant changes will be in human face, say after a million years from today????

Kwan and Lamm teamed up to imagine what the human face *may look like in 20,000, 60,000 and 100,000 years from now and they* hypothesized that it will feature larger fore-heads and massive eyes (Fig 34) with the bigger eyes helpful in low-lighting situations in space (Kwam, 2012). Lamm (2012) hypothesized that this change would result from genetic engineering and wearable computers (think Google Glass)

While some say this is pure fantasy, Mathew Herper of Forbes says that, " For what it is worth, I think Lamm's work is conceptually cool, but wanted to get on-the-record that this is dreaming, not science."

He went further to say "Our future selves will ultimately control human biology and human evolution the way we control the flow of electrons through our electronics today and that in this potential future, humankind has wrested the control of the human form from natural evolution and are able to bend human biology to human needs."

Fig 35: How we might look in 20,000 years to come **How we might look in 60,000 years to come** **How we might look in 100,000 years to come.**



Source: Human race in 100 thousand years: future of our faces.

Conclusion and Recommendations

Mr. Vice-Chancellor Sir, in the course of this lecture, I have elaborated on the contributions of oral and maxillofacial surgery, a branch of dental surgery and my humble contributions to knowledge. These have been done without the use of excessive medical and maxillofacial jargons.

In conclusion, I hereby recommend that:

1. The present Dental Surgery Department is transformed to the Faculty of Dental Surgery, under the College of Medicine, Ahmadu Bello University, Zaria. This is will be the first Dental Faculty in the middle belt.
2. Maxillofacial surgery being a highly technical and capital intensive field needs adequate funding. There is need for government to fund health care so that both healthcare workers and the patients have better services.
3. Since trauma constitutes the bulk of the work of the oral and maxillofacial surgeons, a regional trauma centre should be established in Zaria as part of the ABUTH. Furthermore, traffic rules need to be enforced to minimize road traffic crashes that are the main cause of facial injuries.
4. There is a need to sensitise the populace about oral and maxillofacial diseases by promoting oral health awareness and education.
5. There is the urgent need to include care of maxillofacial diseases among condition covered by the National Health Insurance Scheme to reduce the financial burden of healthcare on Nigerians especially as most patients in our public health facilities belong to the lower socio-economic groups.
6. There is a need for the establishment of a craniofacial team to comprise of pediatric maxillofacial surgeon, pediatric plastic surgeon with expertise in craniofacial deformities, neurosurgeon, pediatric dentist, orthodontist, speech therapist, otorhinolayngologist, ophthalmologist, audiologist, psychiatrist, social worker and genetic counselor.

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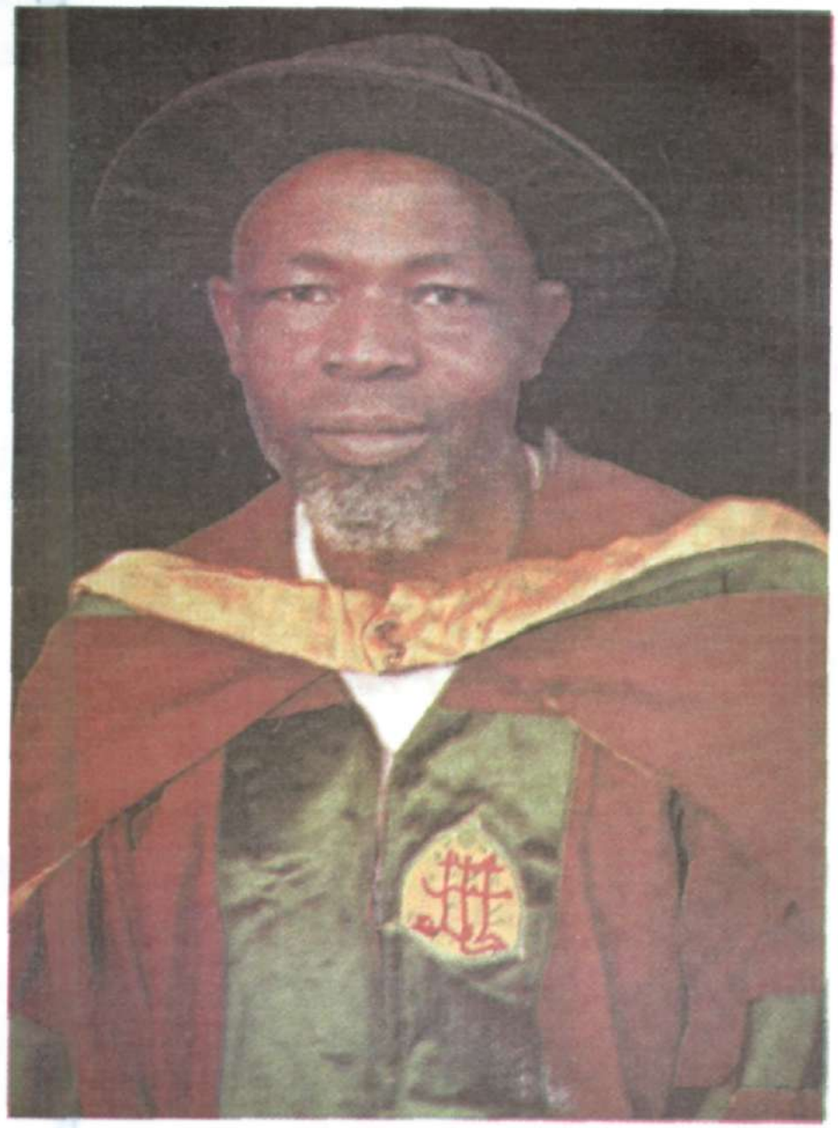
Chapter Eleven

Materials Development: Frontier of Technological Advancement

Materials Development: Frontier of Technological Advancement

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Wednesday, 5th November, 2014



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1.0 Introduction

Technology, general term for the processes by which human beings fashion tools and machines to increase their control and understanding of the material environment. The term is derived from the Greek words *tekhnē*, which refers to an art or craft, and *logia*, meaning an area of study; thus, technology means, literally, the study, or science, of crafting (Encarta, 2009).

Many historians of science argue not only that technology is an essential condition of advanced, industrial civilization but also that the rate of technological change has developed its own momentum in recent centuries.

Materials innovation has been associated with early phase of technological development. For example, it was wide accepted that improved steel products have been important source of improved vehicles, even though it was not clear as to what proportion of the overall technology development in real quantity can be accounted for by materials innovation. Recently, workers have attempted to quantify the role of materials innovation in technological progress. One approach was to analyze major innovations over time from journal articles, key patents and commercialized processes that involved new materials.

2.0 Overview of Trends in Technological Advancement

The trend in technological advancement in the recent past can be discussed for the Energy and Information sectors as illustrations. Energy sector may be sub-divided into energy storage, energy transport and energy transformation while information sector may be sub-divided into information storage, information transport and information transformation.

Figure 1 presents an example of functional performance metric (FPM) for energy transformation in specific power (watts/litre of fuel) from 1890 to 2002. The plots showed the various innovations achieved over time and the exponential improvements in energy transformation over this period (Koh and Magee, 2008). Figure 2 presents a second example of FPM for generic function of information storage in megabit/cc from 1890 to 2004. The plots also showed continuous exponential curve at a greater progress rate than

for energy transformation. Figures 3 to 6 present the FPM for the other sub-divisions of the two sectors.

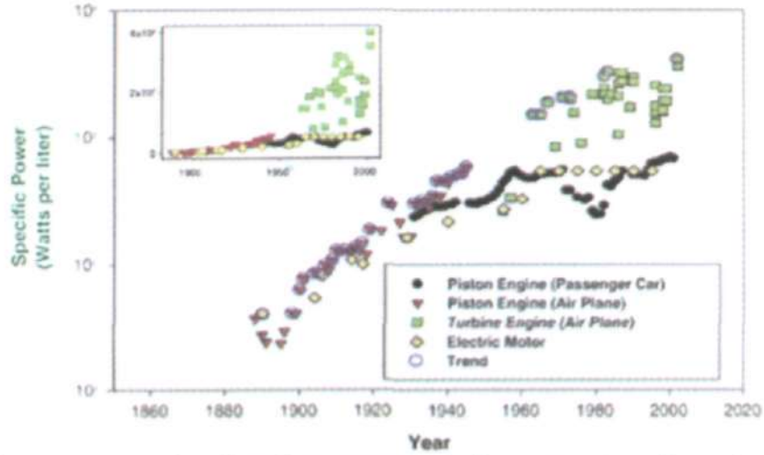


Figure 1: Functional performance metric for energy transformation (Koh and Magee, 2008)

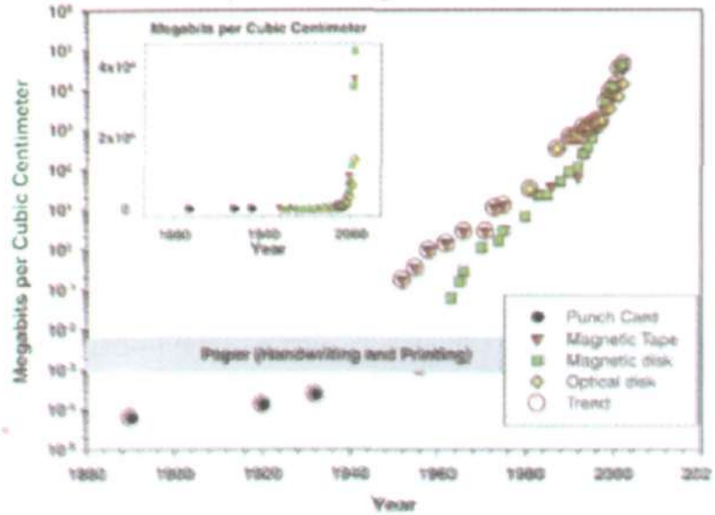


Figure 2: Functional performance metric for generic function of information storage (Koh and Magee, 2008)

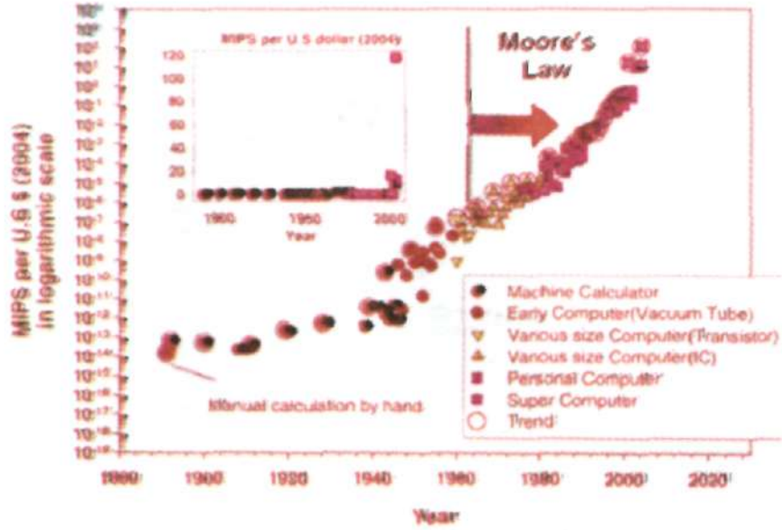


Figure 3: Functional performance metric for information transformation in millions of computations per second per dollar with time

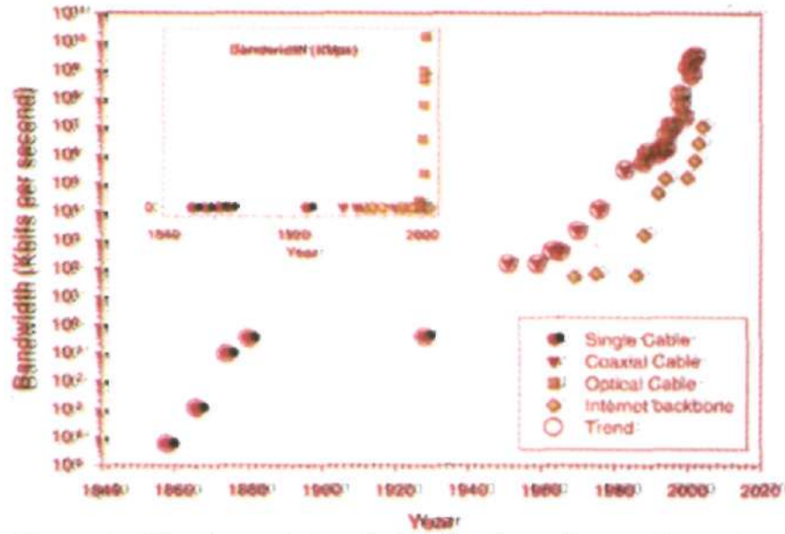


Figure 4: The change in bandwidth for the underseacable system over the past150 years (Koh and Magee, 2008)

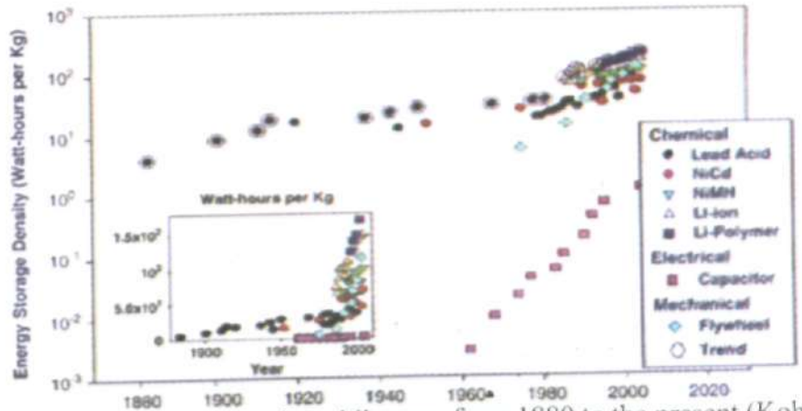


Figure 5: Energy stored per kilogram from 1880 to the present (Koh and Magee,2008)

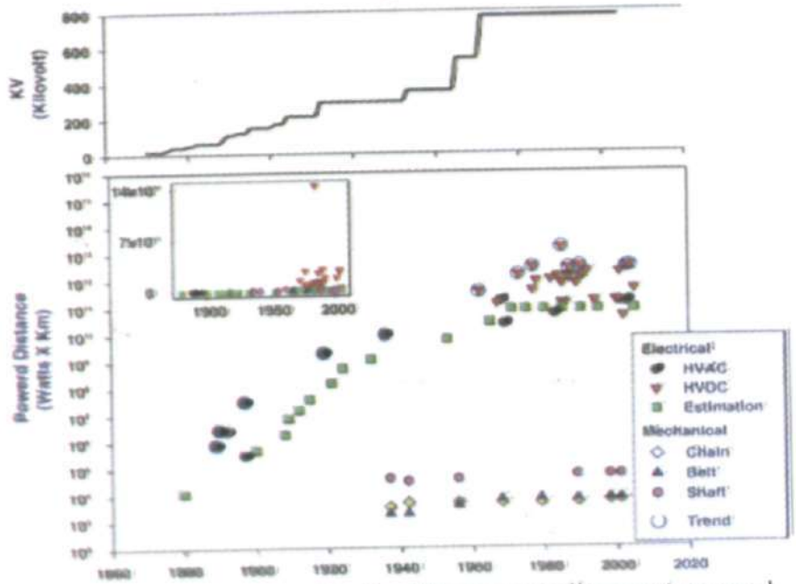


Figure 6: Improvement in feasible power x distance (powered distance) for energy transportation (Koh and Magee, 2008)

3.0 Materials Innovation and its Relationship to Overall Innovation

3.1 Models for Product and Process Innovation

Abernath and Utterback (1996) first differentiated innovation in assembled goods from innovation in homogeneous products, like chemicals and materials which are products of process industries. They found that immediately after the introduction of a product there are a large number of innovations, usually involving new product textures or configurations. And that a dominant design may emerge to, some degree, standardize the product features and configurations in a way that satisfies large number of users. Cost and efficiency then become the competitive basis for increase in product innovation in that industry.

Figure 7 presents Utterback's model for innovation in materials industry in 1996 while Figure 8 presents the Linton-Walsh's model for the same materials industry in 2007. It was clear that product innovation was always ahead of process innovation. It was also observed that the time lag between product innovation and process innovation was significant in the 1996 study but by 2007 the time difference between the two was very short.

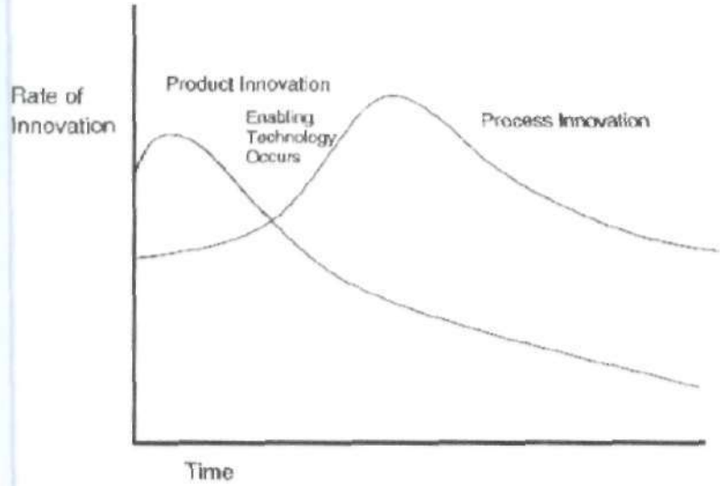


Figure 7: Utterback (1996) model for innovation in materials industry.

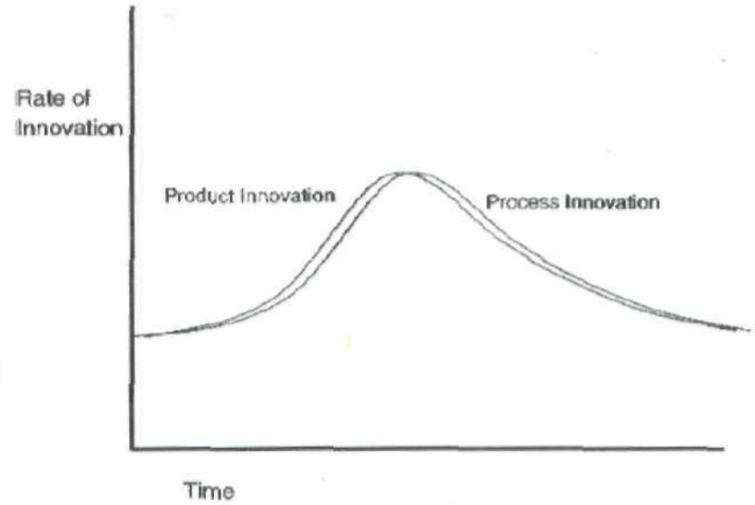


Figure 8: Linton-Walsh (2007) model for innovation in materials industry.

3.2 Hierarchy of Levels of Innovation

A generic hierarchy to describe elements of the changes that occur for improving an overall technical system has been suggested in ascending order as follows:

i. *Incremental improvement in material or process that make* up devices and components in the technical system can improve the overall system performance (i.e. material/process improvement).
ii. Discrete change in the choice of material or process can improve the system (i.e. material/process substitution).
iii. Changes in (non-material or process) parameters that are internal to various devices and components can be made to improve the overall system (i.e. component design).
iv. Changes in relationships among different components and devices that make up the system can be a source of improvement in the overall system (i.e. system redesign).
v. The basic scientific phenomenon being utilized in the system or in devices that are part of the system can be changed in order to improve the overall system (i.e. phenomenon change).

vi. Theoperating procedures for the overall system can be changed to improve the overall system (i.e. system operation).

From the listing material/process changes are ranked the lowest in hierarchies and therefore, easy to miss in identifyingthe most vital changes that resulted in the technological advancement. Tables 1 to 5 present the typical materials innovations for the energy and information sector.

Table 1: Examples of technical changes in the information transport functional category arrayed in the technical change hierarchy

Category of Change	**Examples**
Materials/Process Improvement	Coatings on glass fibers; purity of glass
Materials/Process Substitution	Glass fibers vs metallic conductors
Component Redesign	optical "solitons"
System Redesign	optical amplification
Phenomenon Change	Wireless vs wired transmission
System Operation	TCP/IP; wavelength division multiplexing

Table 2: Examples of technical changes in the energy storage functional category arrayed in the technical change hierarchy

Category of Change	**Examples**
Materials/Process Improvement	Lead casting techniques
Materials/Process Substitution	Lead to Ni-Cad to Li-ion
Component Redesign	Honeycomb structures for anodes
System Redesign	Parallel cells
Phenomenon Change	Batteries to capacitors
System Operation	Charge sensing

Table 3: Examples of technical changes in the energy transport functional category arrayed in the technical change hierarchy

Category of Change	**Examples**
Materials/Process Improvement	Al purity
Materials/Process Substitution	Insulators to allow higher AC voltage
Component Redesign	Ball bearings
System Redesign	Transformers and voltage step-down
Phenomenon Change	Mechanical to electrical transmission
System Operation	AC vs DC power

Table 4: Examples of technical changes in the information storage functional category arrayed in the technical change hierarchy.

Category of Change	Examples
Materials/Process Improvement	Improvements in integrated circuit technology
Materials/Process Substitution	New optical and magnetic materials and processes
Component Redesign	Magnetic disks vs. magnetic tape
System Redesign	Magneto/optical storage
Phenomenon Change	Mechanical to electronic and magnetic optical
System Operation	Database architecture

Table 5: Examples of technical changes in the energy transformation functional category arrayed in the technical change hierarchy.

Category of Change	Examples
Materials/Process Improvement	Improvements in high temperature alloys – Ni based, etc
Materials/Process Substitution	Ni for Fe, ceramics for metals
Component Redesign	Fuel injectors
System Redesign	Feedback control for combustion
Phenomenon Change	Electric motors vs. combustion engines
System Operation	Control strategies for engines and motors

Magee (2010) adopted quantification methodology and found that about 2/3 of the total progress in computation over the past 40 years has been due to materials/process innovations. He also found that the contribution of materials/process innovations in energy storage were possibly 80% or higher and that the relative contribution of materials/process innovation to overall technological progress had grown in the past few decades.

4.0 Indigeneous Efforts in Materials Development

Efforts are continuously going on in Nigeria to research into new and advanced materials among the tertiary institutions and research centers. Raw Materials Research and Development Council (RMRDC), Abuja at various times set up three teams of expert between November 2007 and June 2009 to develop a blueprintdraft blue-print for the development and utilization of new and advanced

materials in Nigeria. The expert groups, in succession, finally produced a document which spelt out possible intervention strategies in the short, medium and long term.

In Ahmadu Bello University several research and development works have been carried out in many departments, includingthe Department of Chemical Engineering.

4.1 History of the Department of Chemical Engineering

The Department of Chemical Engineering at Ahmadu Bello University, Zaria was established in 1973 initially as the Industrial Chemistry Section of Chemistry Department in the Faculty of Science and then later transformed into the full fledged Chemical Engineering Department in the Faculty of Engineering in October 1976. The Department was established with the assistance of the Dutch Government through Twente University of Technology, Enschede, the Netherlands, under a ten-year (1972 – 1982) cooperation programme between Ahmadu Bello University and the Netherlands University Foundation for International Cooperation (NUFFIC).

The philosophy of the research programme of the department was to focus on appropriate technology, particularly relevant to the Nigerian situation. At the beginning of the postgraduate programme in the department specialization at M.Sc. level was either in Process Engineering or Materials Engineering. Through this programme many research activities on advanced materials were carried out. Some of these are discussed here.

4.2 Crashworthiness Automobile Vehicle Body

Crashworthiness is the ability of a structure to protect its occupants during an impact. This is commonly tested when investigating the safety of vehicles (Wikipedia, 2009).The crashworthy systems and devices installed in modern vehicles to prevent or reduce the severity of injuries when a crash is imminent or actually happening are as follows:

- Seatbelts
- Airbags
- Laminated windshields
- Tempered glass
- Bumpers
- Safety cells
- Cargo barriers
- Crumple zones

- Automatic brake system
- Anti-intrusion bars
- Pedestrian protection systems
- Collapsible steering columns

Roadworthiness
Internal Padding
Driverless vehicles
Self-sealing fuel tanks

Table 6 presents a fatality analysis which showed that the countries implementing these measures were achieving safety performance improvements over time. However, Figure 9 showed that in Nigeria the casualties from vehicular road accidents increased from 2004 to 2009.

Table 6: Fatality Analysis Report of Some Countries.

	1979 Fatalities	2002 Fatalities	Percent Change
United States	51,093	42,815	-16.2%
Great Britain	6,352	3,431	-46.0%
Canada	5,863	2,936	-49.9%
Australia	3,508	1,715	-51.1%

There was a need to adopt a better strategy. A glass fibre reinforced carbon-natural rubber composite was being developed for the automobile body. Figures 10 and 11 present the mechanical properties of the composites with varying carbon and glass fibre contents. Figure 10 showed that a body composition with 21wt% had optimum strength properties while Figure 11 showed that 25wt% glass fibre content was equally considered as optimum. Further tests are ongoing in the areas of re-bounce and energy recoverable capacities to ascertain their suitability to replace the present automobile bodies. This is the first time natural rubber would be investigated for automobile body use and it is futuristic.

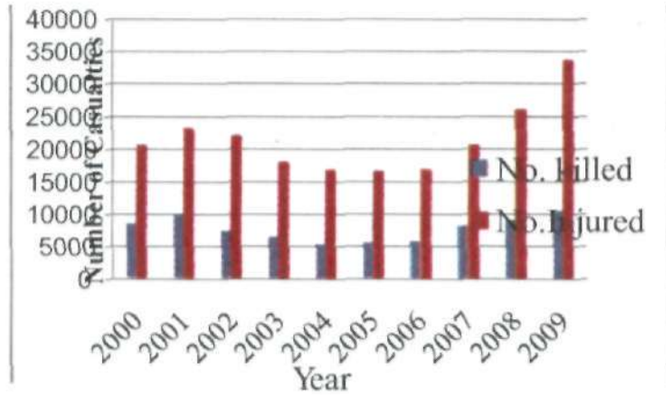


Figure 9: Number of Casualties on Yearly Basis (FRSC, 2010)

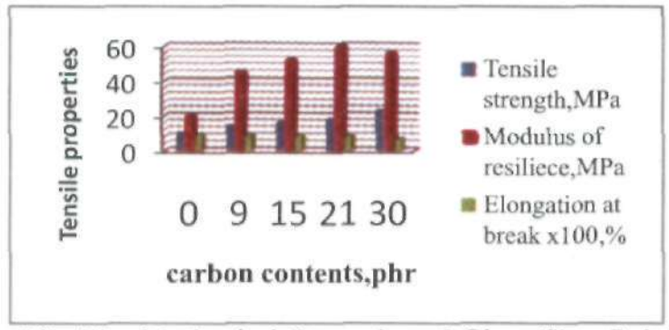


Figure 10: The Mechanical Properties of Glass fibre Reinforced Carbon-Rubber Composite with varying Carbon Content.

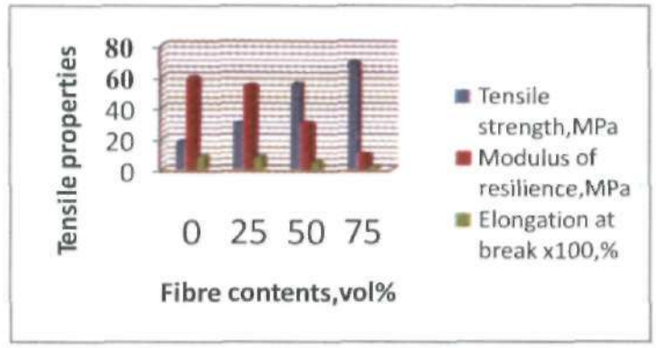


Figure 11: The Mechanical Properties of Glass fibre Reinforced Carbon-Rubber Composite with varying Glass Fibre Content.

4.3 Zeolite Catalysts

Zeolite catalysts are commonly used in the petroleum refining and petrochemical industry for a variety of applications, ranging from catalytic cracking of heavy fuels to isomerization and aromatization of petrochemical feedstock. Zeolite Y was first synthesized in the sixties and introduced to the fluid catalytic cracking of heavy fuels in the seventies. At that time the zeolite Y was produced by partial de-alumination of kaolin. Currently, higher quality zeolite Y is produced either by incorporation method from high purity chemicals or by the patented Engelhard method from kaolin and high purity chemicals.

The research team at the PTDF Professorial Chair in Chemical Engineering has developed new process route through which high quality zeolites (zeolite Y and ZSM-5) were produced from kaolin from Kankara town in Katsina State of Nigeria. The ZSM-5 prepared also had shorter crystallization time of 4 days when compared to 7 days for conventional methods. The zeolites were compounded into catalysts and tested both within and outside the country. The characterization and performance tests carried out revealed that a blend of the two catalysts prepared outperformed the commercial catalyst presently used at Kaduna Refining and Petrochemical Company. Pilot plant units have been designed and fabricated to produce the catalysts. The units are due to be commissioned before the end of the year 2014. The data and images generated from the studies are presented in Tables 7 to 9, Figures 12 to 16 and Plates 1 to 5.

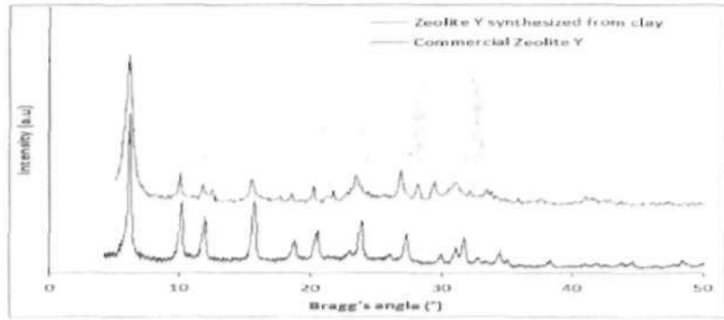


Figure 12: X-ray diffraction patterns of the zeolite Y synthesized from kaolin using the novel processing method and a commercial zeolite Y.

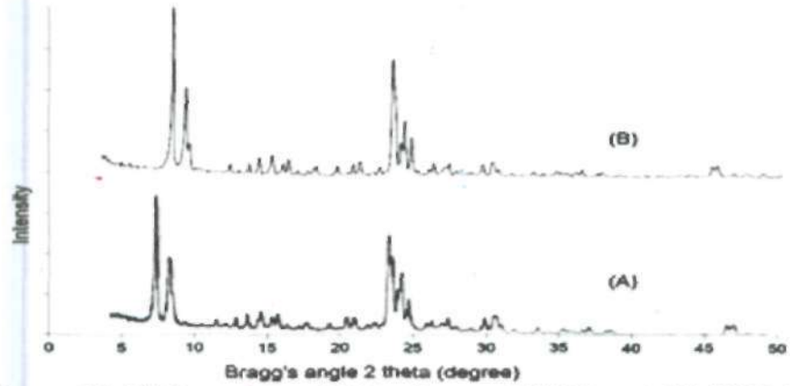


Figure 13: XRD patterns of (A) reference ZSM-5 and (B) ZSM-5 prepared from kaolin

Table 7: Chemical composition of the zeolite Y prepared from kaolin using the novel processing method

Oxide	Al_2O_3	SiO_2	CaO	TiO_2	Cr_2O_3	Fe_2O_3	SO_3	*LOI*
wt%	*20.48*	*51.32*	*0.3*	*0.04*	*0.04*	*0.71*	*ND*	*26.5*

***Table 8:** BET surface area and pore sizes of the zeolite Y synthesized from kaolin using the novel processing method*

SAMPLE	SURFACE AREA (m^2/g)	PORE VOLUME (cm^3/g)	PORE DIAMETER (Å)
Zeo-AY: NaY	732.0	0.2611	14.26

Table 9: Physicochemical properties of ZSM-5 synthesized from kaolin

Component	SiO_2	Al_2O_3	Fe_2O_3	Na_2O	CaO	TiO_2	External surface area (m^2/g)	BET surface area (m^2/g)
Kaolin ZSM-5 (wt.%)	98.06	1.27	0.065	0.27	0.269	0.019	160.37	415

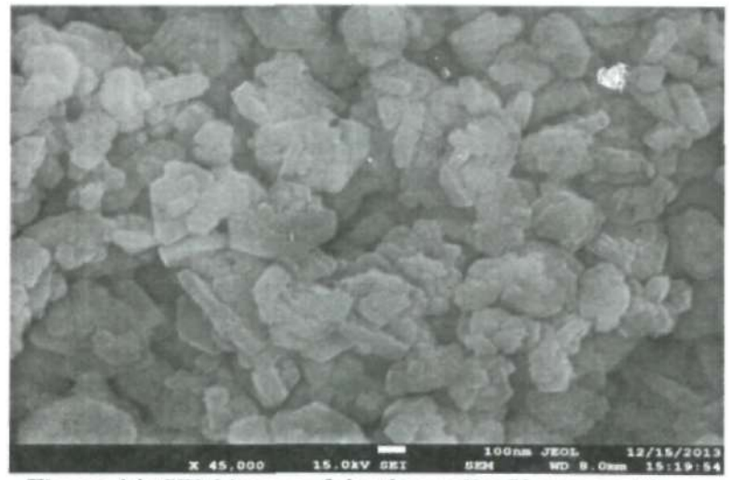


Figure 14: SEM image of the the zeolite Y prepared from kaolin using the novel processing method

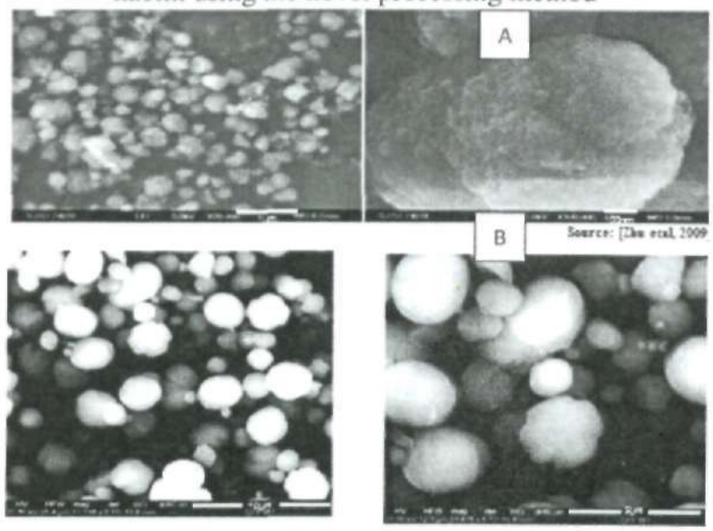


Figure 15: SEM images of (A) reference ZSM-5 and (B) ZSM-5 synthesized from kaolin

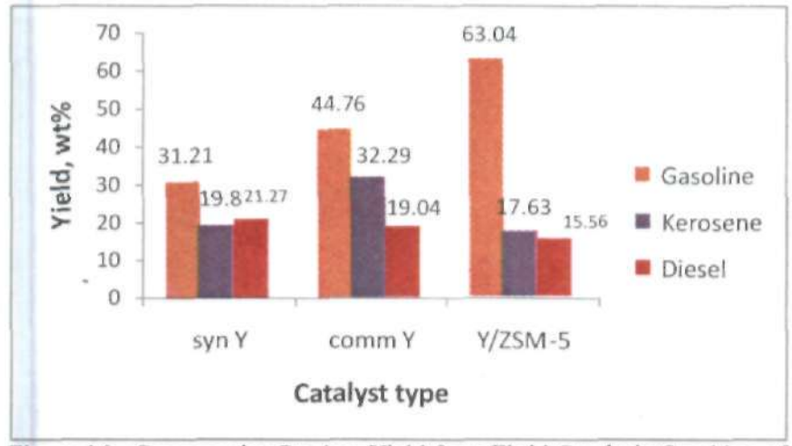


Figure 16: Comparative Product Yield from Fluid Catalytic Cracking of Heavy Gas Oil Using Different Catalysts



Plate 1: Kaolin purification pilot plant unit



Plate 2: Dealumination unit



Plate3: Aluminium hydroxide reactor



Plate 4: Sodium silicate production unit



Plate 5: Zeolite reactor

4.4 Personnel Armor

Personnel armor is any equipment of various materials, used to protect a body in combat. The oldest of protective devices is the

shield; the earliest body armor was a wide belt to protect the abdomen. The modern personnel armor is made of thin layer of special metal, and of recent fibre reinforced composites. In the department research work has carried to develop fibre reinforced polymer composites that were found to withstand medium range velocity projectiles. Glass fibre, Nylon fibre, Kevlar fibre and Aramid fibre were used as the reinforcement fibres in various combinations. Polyester and acrylonitrile butadiene styrene (ABS) were also used as the matrix for the composites. ABS was also recycled from inner lining of used and discarded refrigerators; this could be used for producing cost effective armor materials to protect against projectiles from small fire arms.

4.5 Other Materials

Research and development works were also carried out in the areas of dense and insulating fireclay refractories, graphite crucibles and bentonites.

5.0 Conclusions

The following conclusions may be made from the works carried out so far.

- The dominant role of materials development in the technological advancement over 40 years was demonstrated. Quantification methodology estimated that materials innovations accounted for about 2/3 of the total technological progress in information transformation generic functional area in the last 40 years while the contribution of materials/process innovations in energy storage were possibly 80% or higher.
- An energy recoverable composite with anoptimum composition of 21 parts per hundred rubber (phr) carbon and 25vol% glass fibre contents giving tensile strength, MOR and elongation at break of 29MPa, 54MPa and 800% respectively was developed forautomobile vehicle body. These values compared well with those of reported commercially for similar reinforced polymers [tensile strength (8.3 to 15MPa), MOR (25 to 50MPa) and elongation at break (400 to 850%)]. The density of the composite was 1,900kg/m^3 which was lower than commonly used metals (Al 2,700kg/m^3 and mild steel 7,850kg/m^3).

- Zeolite Y and ZSM-5 catalysts were prepared from kaolin by a novel method which entailed clay-split method. A blend of the two catalysts prepared outperformed the commercial catalyst presently used at Kaduna Refining and Petrochemical Company. Pilot plant units have been designed and fabricated to produce the catalysts.
- Fibre reinforced polymer composites with various reinforcement and matrix materials were developed and found to withstand medium range velocity projectiles

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Chapter Twelve

Newborns, Infants, and Grown-up Children (Adolescents): Embers of Researches, Ideas, and Advancement

Newborns, Infants, and Grown-up Children (Adolescents): Embers of Researches, Ideas, and Advancement

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Acknowledgment

Wherefore seeing we also are compassed about with so great a cloud of witnesses, let us lay aside every weight, and the sin which doth so easily beset us, and let us run with patience the race that is set before us.

Hebrews 12.1

Ladies and gentlemen, I will like to end this lecture by expressing my sincere gratitude to the Vice Chancellor, Ahmadu Bello University and the entire university community, not only for the singular honour of giving this lecture, but also for providing an environment that is conducive for learning, research, practice, growth and development and for running the race. I am not too sure of where I would be without this great university. I must thank the VC especially for encouraging the regular presentation of inaugural lectures in the university. I can only say the name and sweet memory of Ahmadu Bello University, Zaria, this intellectually and physically gigantic institution, will remain with me till I breathe my last.

I must appreciate my Dean, Professor AG. Bakari, for committing the Faculty of Medicine, one of the greatest Faculty (if not the greatest), to regularly take part in the inaugural series. Mr. Dean, I remember our days as neighbors in Gaskiya, when we were "growing up". Thank you for nominating me to represent the Department of Paediatrics of Ahmadu Bello University.

I thank all my colleagues, senior, junior and contemporary, and all postgraduate (resident) doctors in my department, for the support enjoyed over the years. There is no way I could come so far without you. I also thank my colleagues and friends in other departments, both medical and non-medical for their being there when needed. I must make mention of Professor JO. Hambolu who persistently prod me to move on along the carrier ladder. I pray that the Almighty God will continue to prosper all your ways.

I must acknowledge my alma mater, the University College Hospital/University of Ibadan, for turning me into a medical doctor in the first place.

I thank my parents for having me. It is one thing to give birth to a child, it is another issue to nurture the child. This is one huge area we have problems with in Nigeria and it should be of great concern for anyone with any positive outlook for the future of our great country, which can truly be great in the real sense of the word.

I thank you, my wife, Mrs. Olufunmilayo Rebecca Ogunrinde, Mama T, for your love and support; for being there during the struggle to make headway in academic affairs, and indeed, in other areas of my life and wellbeing. I thank my children, Olwatobiloba, Oluwadara and ModupeOluwa. They have made everything worthwhile and have pushed ahead, and still pushing, like normal offspring.

I thank all the children I have come across, and still encountering, who are unfortunately labelled as patients. I will like to label them as my children. Unfortunately, a significant number of them are no longer with us on this side of the divide by virtue of myriads of problems they faced at the time of dire needs.

> Long live Nigeria, the good name inspiring the title of this lecture and actually is the title. Long live Ahmadu Bello University, the birthplace of so many great ideas, in itself the gestational product of a great mind. Long live the Department of Paediatrics, one of the best in the country, the handiwork of great teachers and great colleagues. Thank you, ladies and gentlemen, for your patient and kind attention.

> *I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong, neither yet bread to the wise, nor yet riches to men of understanding, nor yet favour to men of skill, but time and chance happeneth to them all"*
>
> ***Ecclesiastes 9:11***

Introduction

The Vice Chancellor, Ahmadu Bello University, Zaria, the Deputy Vice Chancellor (Academics), the Deputy Vice Chancellor (Administration), the Registrar, the University Librarian, the Bursar, Dean Faculty of Medicine, Deans of other Faculties, Directors of Institute, Heads of Department, senior Professors (my teachers),

other highly esteemed Professors, members of academic and non-academic staff, students, other members of the university community, ladies and gentlemen.

I thank the Almighty God, Maker of heaven and earth, God of Abraham, Isaac and Jacob, the Beginning and the End, for this wonderful opportunity offered me to give my inaugural lecture as a professor of Paediatrics. I return all glory and adoration to Him.

I will like to start this lecture by letting people know why I chose Paediatrics as a field of interest. I have an inkling that some in the audience may want to know why. It is proper to let you know. Until I graduated from the Medical School (now College of Medicine), University College Hospital, Ibadan, I had no clue as to what I was going to be apart from being a medical doctor and be able to heal sick people, hopefully. As a medical student, I was too busy learning medicine to actually recognize the patients. It was a hectic schedule and there were occasions when I doubted if it was possible to complete the medical education. However, during my internship year in UCH, Ibadan, when the practical aspects of medicine rather than theory were now routine the patients swam into sharp focus. The order of my internship in the four clinical departments was Paediatrics, Obstetrics/Gynecology, Medicine and lastly Surgery. Without trying to deride anyone and bearing in mind that first impression may be influential, I found the patients in the Department of Paediatrics to be very friendly and very forthright. They have this eagerness to get well soon and get back to the routine of life as quickly as possible. Very importantly, children hardly have overt psychiatric manifestations and psychiatry was my worst subject as a medical student. In fact, the day I watched a young man in Aro Psychiatry Hospital, Abeokuta, being given the electroconvulsive therapy (a kind of shock therapy) I knew I was never going to be a psychiatrist. The thrashing about and convulsions induced in the young man had a severe negative impact on me. During my internship, I soon grew tired of the very complex natures of adult symptoms, many of which had no organic basis and probably reflected cultural bias. I have heard of people having headaches, but it was new when the headache went round the head seven times, then travelled to the shoulder, stayed there for three days, move back to the head, and it would go on and on. Whereas an adult would still like to stay in bed and be pampered even when he

is 95% healed, at 50% a child is already trying to get out of bed to start playing. What a fantastic way to demonstrate healing. While I had frowning and complaints from adults one was helping, from children it was always crying (not from anger) to be followed on many occasions by those beautiful smiles that are still quite rewarding. When I started out as a lecturer and paediatrician in 1997, in addition to the teaching, I was entrusted with the care of children in the following areas: nutrition, cardiology and pulmonology, and sickle cell disease. Later I got more involved in the care of children with cancers (oncology). Over the years I settled into paediatric haematology (the branch of paediatrics devoted to the study of blood, blood-producing tissues, and diseases of the blood) and paediatric oncology (the branch of paediatrics that deals with the study and treatment of malignant tumors).

What is Paediatrics?

Paediatrics is the sole discipline concerned with all aspects of the well-being of infants, children, and adolescents, including their health; their physical, mental, and psychological growth and development; and their opportunity to achieve full potentials as adults. [1] The word *paediatrics* means "healer of children"; it is derived from two Greek words: pais "child" and iatros "doctor, healer". [2] As paediatricians, we are concerned not only with particular organ systems in the body of the child, but also with environmental and social influences, which have a major impact on the physical, emotional and mental health and social well-being of children and their families. [1] Children are among the most vulnerable and disadvantaged members of society and their needs require special attention. The age range defining children varies but it is from birth and to, usually, 18 years of age. There are occasions when a paediatrician is called upon to assess the suitability of the scheduled birth of a newborn-to-be, while still in the uterus, to determine if the baby is matured enough to survive outside the womb. In this case the lower age limit defining our patients may shift to the left side of day one. The entire purpose of paediatrics is the advancement of the well-being of children. Paediatricians must be advocates for the individual child and for all children, irrespective of culture, religion, gender, ethnicity, race, or of local,

state or national boundaries. Children, ordinarily, cannot advocate for themselves. [1]

Historical Perspective

Paediatrics as a medical specialty, when compared to other areas of medicine is relatively new, coming into existence just under two centuries ago with the campaign of Francesco Fede (1832-1913), a professor of paediatrics at the University of Naples. [3] However, ancient medical literature includes write-ups concerning children, many of which are still relevant today. For instance, Ibn Qayyim al-Jawziya (1292-1350) from Damascus wrote a child-rearing manual called Tuhfatul Mawdud bi Ahkam al-Mawdud (A gift to the loved one regarding the rulings of the newborn), in which care of the newborn is discussed. [3] The Ebers Papyrus, written about 1552 BC and unearthed in 1872, discussed, among other topics, breastfeeding, a cure for worms, and treatment of eye diseases. [4] Writings of Hippocrates (c. 400 BC) covered cephalhaematoma, hydrocephalus, clubfoot, worms, diarrhoea, asthma and mumps. [4] Galen (c. AD 200), Greek philosopher, surgeon and physician, wrote of ear discharge, pneumonia, and intestinal prolapse, and described a disorder that corresponds to rickets, a disease that is found only in children. [4] In 1583, Hieronymus wrote what was described as the first important printed book about children, entitled *De Morbus* Pusiorum (disease of the little boy). Thomas Syndeham (1624-1689) wrote on scarlet fever, measles, small pox, epilepsy, rickets, teething fever, scurvy and the chorea we now know as St. Vitus Dance. By the late 1700s and early 1800s, the need to attend specifically to the care, development, and the diseases of children became more apparent, and specialization in paediatrics evolved particularly in Germany and France. [4] Some of the oldest traces of paediatrics can be discovered in Ancient India where children's doctors were called *kumara bhrtya*. [2,3]

Paediatrics in Nigeria

Before the advent of orthodox medicine in Nigeria traditional medicine was established. This was practiced by, among others, "specialist" birth attendants. These practitioners did not share

knowledge and kept their skills closely guarded family secrets to protect their means of livelihood. [5,6]

Some of the measures that were used to try to improve or mitigate childhood mortality in those very early days included: [5]

1. The use of charms (or juju) to protect against witchcraft;
2. Use of cow's urine to arrest convulsion, and the bodily application of hot objects to revive the unconscious victims of convulsion;
3. The use of cow dung for the treatment of the umbilical cord of the newborn;
4. Infanticide was used as a means of ridding the society of congenital malformations; part of the congenital malformation apparently included twinning in some parts of the country.

Of course, we now know to a good extent that these are injurious practices. Unfortunately, many of these practices are still commonplace in the country. According to my teacher, Professor AM. Yakubu, [5] modern scientific medicine was introduced into Nigeria by the Portuguese for the their traders and sailors coming to the West Coast of Africa as far back as the 15th Century. Gradually over time, Nigerians started to enjoy these services. In Nigeria, the path towards emergence of paediatric care by paediatricians has been long and tortuous but by the time of our independence in 1960 there were general hospitals and some elements of specialist care like the Massey Street Hospital in Lagos. [5,6] Massey Street Hospital is actually the first children's hospital in Nigeria. [5] According to Yakubu, Nigerian pioneer paediatricians were/are Drs. Animashaun, Ajenifuja, Fadahunsi and Ekpechi. Tertiary paediatric clinical services started in UCH, Ibadan and later in LUTH, Lagos. [5]

The first academic Department of Paediatrics was established in the University College Hospital, Ibadan.

Postgraduate training in Paediatrics started in Nigeria in 1969.

Paediatrics in Zaria

In Ahmadu Bello University, the Department of Paediatrics was created in the Faculty of Medicine in 1969 when the pioneer

batch of medical students entered into the clinical years of their training. [5] Prior to this time, children were admitted into the female wards of the hospital. The first head of department was Professor Sinette, an African American. He was succeeded after a brief period by Professor Richard Dobbs, an Englishman. The academic staff then comprised of foreigners, mainly Americans and British. [5] The first Nigerian head of the Department of Paediatrics, Ahmadu Bello University, was Professor MB. Abdurrahman, whom I have the honor of knowing tangentially, and also of learning from, both in person and from reading some of his many writings. The late Professor Kunle Ijaiya, a former Dean of the Faculty of Medicine, took over from Professor Abdurrahman. Then came Professor AM. Taqi, Professor AM. Yakubu (a former Dean of the Faculty of Medicine and a one-time Chief Medical Director of Ahmadu Bello University Teaching Hospital, Zaria) and Professor WN. Ogala (a former Deputy Dean of the Faculty of Medicine, ABU, and presently a member of the Board of ABUTH, Zaria). I have the honor of working closely with the last two, in their own right doyens of paediatrics in Nigeria and abroad. Under their guidance (and that of Professor HA. Aikhionbare, also a former Dean of the Faculty of Medicine) the Department of Paediatrics of our University has grown into, and remains, one of the best in the country. Under their tutelage I have become what I am today.

The Newborn and the Infant

The Newborn

The birth of a child, after 40 weeks of complex development in the uterus, can be described as traumatic, indeed, very traumatic. It is traumatic for the mother (hopefully with pleasant memories) and for the newborn who, thankfully, is oblivious of what is happening. The management of this point in time (the starting line of life's race) goes a long way in shaping the future of the child as an individual, as a member of the society and as a productive workforce. Poor attention at this critical period, and during the first 28 days of life, both in the hospital and community settings in Nigeria, contribute significantly to morbidity (quality of life) and mortality (decreased life span). A baby aged between one and 28

days is referred to as a neonate. Many years ago we published a case of gishiri cut that inflicted severe damage to the scalp of a neonate.[7] Up till that point in time virtually all the complications arising from this traditional practice were reported in the mothers.[8,9] Harrison described the rare complication in which the mother's bladder and urethra were completely divided, the peritoneal cavity opened, and the foetus injured.[9] But the type of foetal injury was not described. Ours was the first clear cut recorded instance of a direct harm to the baby (Picture 1). The "gishiri" cut is the local equivalent of episiotomy, a cut that is normally applied to the opening of the birth canal to facilitate birth of the head of the baby. Episiotomy requires the skilled used of a special pair of scissors. In the case just mentioned a long knife or razor blade was probably used and by a traditional birth attendant with no training in dealing with complicated births.[10] This apparently caused inadvertent injury to the baby. Apart from the deep laceration, the baby was brought with copious pus production from the wound. It was also noted that the cut was just one or two centimeters from the anterior fontanel. Fortunately, the baby made a full recovery with the administration of potent antibiotics and staff dedication of those days and was discharged after 11 days. The sad aspect was the fact that the baby had to spend 11 of the first 14 days of his life on admission, which cannot be described as a good start in life. Many mothers, for various reasons, some of which may be considered valid, still prefer to give birth at home without skilled supervision and within relatively unhygienic conditions.[11] When there are confounding variables like precipitate labour the results may be catastrophic. A nine-day old baby boy once presented to us with 8 days history of right-sided scalp swelling, 6 days of intermittent fever and excessive crying.[12] The child was delivered at home after a precipitate labour (unusually rapid labour and birth). At the time of birth the mother did not notice any abnormality. There was no skilled birth supervision. On the second day a swelling was noticed on the right side of the head and on the third day the baby had a traditional uvulectomy. When seen, the child was quite sick with pus coming out of his "eyes" and had this big swelling on the right side of his head which made him more irritable when touched. (Picture 2). Initial thought was that blood must have collected in that part of his

head after the precipitate labour and was most likely infected. Despite antibiotics given intensively through his vein the swelling started discharging pus which was not foul-smelling and did not grow any organism on culture. The baby eventually had a minor surgery to evacuate the pus and spent 22 days in the hospital. Here again, the first month of his life was spent sick from preventable illness. Not really the kind of start one would want in life. These are just two lucky fellows having access to medical care, even if their presentations were late.

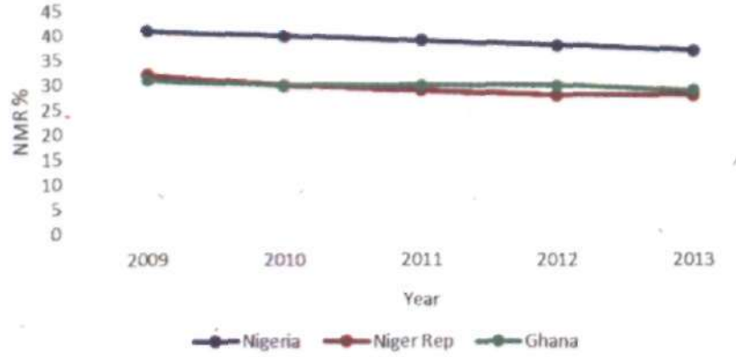
The neonatal period is critical with the baby undergoing rapid transition from intrauterine to extrauterine existence. Birth defects usually become quite manifest and take their toll. The constant supply of nutrition the child was exposed to prior to being born will now be supplied in an intermittent fashion. The child is now exposed to a hostile environment instead of the clean and cozy intrauterine space. Infections may become established and overwhelm the immature immune system of the newborn. Infections constitute a common cause of ill-health in the newborn as we showed in a prospective study designed to identify bacterial causes of neonatal sepsis in ABUTH, published in 2008. In the study we found that 30.4% of babies born within our facility requiring special baby care and 38.0% of babies born outside but admitted into our hospital had culture-proven blood infection (bacteraemia). [13] It is pertinent to note that there was no significant difference in the proportions of these babies with culture-proven infections and this points to the high risk of neonatal sepsis in our setting. Not surprisingly, we found *Staphyloccus aureus* to be the commonest causative organism in out-born babies while streptococcal species were the most frequent in the inborn group of babies.

Neonatal mortality rate (NMR) is the number of neonates or newborn dying before reaching 28 days of age, per 1,000 live births in a given year. Neonatal health is a sensitive indicator of national development. [11]

In 2013, globally, NMR represented 44% of all deaths in children aged less than 5 years. [14] In Nigeria, as at 2011, one-quarter of all U-5 deaths occur in the newborns, approximately 241,000 babies per year. [11] NMRs have been declining gradually in Nigeria but, remains unacceptably high compared to some sister African

countries (Figure 1). [15] As at 2011, Nigeria is said to contribute about 8% of global neonatal deaths. This is obviously unacceptable.

Figure 1. Trends in NMR in selected sub-Saharan countries



It is very likely that the figures being reported are gross underestimations as registration of births and deaths is not mandatory in the country. As such, there would not be any accurate data from the community and figures being quoted would represent institutional data; these often do not necessarily reflect what is going on in the community. Reasons for the relatively high NMRs in the country include:

i. Poor antenatal care, in terms of inadequate availability (equity of distribution) and low utilization of facilities. Only 6 of 10 expectant mothers seek antenatal care from trained medical personnel. [16]
ii. Poor maternal status. Many mothers (including expectant mothers) are poorly nourished, stunted, overworked, and with such conditions as illiteracy and anaemia. Early child bearing and closely spaced pregnancies also negatively affect maternal status. [17]
iii. Unskilled and unsafe birth practices. Many, if not most, of the deliveries in the rural areas of Nigeria are attended to by traditional birth attendants as in the days of old. Almost 40% of women in Nigeria give birth with just a family member or

no skilled attendant present. [11] The proportion of home births in northwestern Nigeria is 90%. [11] Due to their lack of training, these TBAs are unskilled in modern practices and are dangerous. Some factors like inadequate cord care, letting the baby stay wet and cold, discarding colostrum and feeding other foods are prevalent in the setting of unsupervised delivery and contribute significantly to early neonatal death.

iv. Dearth and inequitable distribution of paediatricians (and other doctors and health workers) between urban and rural settings.
v. Severe infections, like tetanus and neonatal sepsis, which tend to occur at home and contribute massively to unrecorded mortality.
vi. Birth asphyxia, trauma and injuries.
vii. Congenital abnormalities of varying severity.
viii. Poor management of the first few minutes of life: not starting appropriate feeding as soon as possible after birth, keeping the wet baby including the unnecessary need to bath the baby immediately after birth, and inappropriate cord care.

These are just a few examples of the myriad of problems faced by newborns in Nigeria and contributing to high NMR in the country, and in the developing nations of the world. Problems such as obtaining money for treatment, distance to health facilities and having to take transport to such facilities are some of the many difficulties by women describing the difficulty with accessing healthcare. [16]

Some factors predisposing the newborn to infections, and thus high risk of mortality, that we identified in Zaria included: [18]

i. Lack of antenatal care,
ii. Prolonged rupture of membranes,
iii. Prolonged labour,
iv. Preterm delivery, and
v. Perinatal asphyxia.

Good antenatal care can prevent the major causes of neonatal mortality in Nigeria – neonatal tetanus, malaria and maternal anaemia. [16] It has been estimated that up to two-thirds of newborn deaths could be prevented if skilled health workers perform effective health measures at birth and during the first week of life. [11]

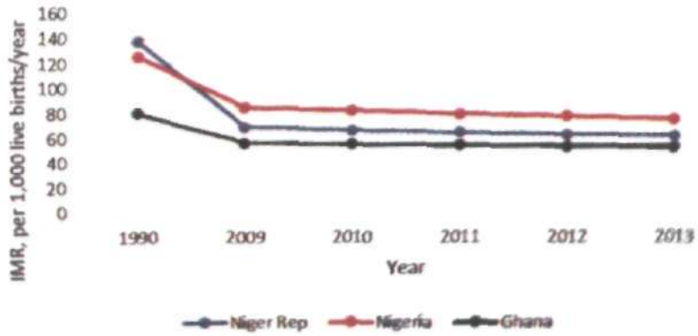
As was pointed out earlier, some issues that contribute to the poor management of the first few days and weeks of life include weak health infrastructure and harmful cultural and traditional practices. Hopefully, these harmful practices have reduced in frequency of occurrence. It has been estimated that up to 70% of newborn deaths could be averted if essential existing health interventions can reach all Nigerian women and newborns. [11] Healthy home practices and community-based care, which are possible to improve, could save over 90,000 babies a year. [11]

The Infant

Who is an infant? An infant, in the context of *Homo sapiens*, is the very young of human. The word infant comes come from the Latin word *infans* which means unable to speak or speechless. For the purpose of this lecture an infant is a child aged between 1 and 12 months.

The death of a baby before his or her first birthday is called infant mortality. The *infant mortality rate* is an estimate of the number of infant deaths for every 1,000 live births in a given year. This rate is often also used as an indicator to measure the health and well-being of a nation, because factors affecting the health of entire populations can also impact the mortality rate of infants. [19,20] Presented in Figure 2 is the infant mortality rates of Nigeria, Niger Republic and Ghana, two of our close neighbours. Compared to the 1990 figures all three countries have reduced IMR, Niger Republic by 56.6%, Nigeria by 41.3%, and Ghana by 35.0%. This is far short of the 66% reduction we are supposed to witness by next year which should see figures like 46 coming out Niger Republic, 42 from Nigeria, and 26 from Ghana. These are figures all nations agreed to under the Millennium Development Goals which I will touch on briefly shortly.

Figure 2. Trends in IMR in some selected African countries



Incidentally, causes of or contributors to IMR in Nigeria are mostly preventable or treatable conditions like: malaria, diarrhoea, pneumonia including pulmonary tuberculosis, measles, HIV, and malnutrition (undernutrition, particularly in Nigeria). Even though I mentioned malnutrition last, it actually sits on top of the pile as it contributes directly and indirectly to more than 55% of IMR and under-5 mortality in the country. On its own, severe malnutrition is a prominent killer of children. When it occurs, it will also lower the child's immunity and predispose the child to severe forms of infections and other medical conditions. Infections will reduce the appetite of the children reducing their intake and worsening the malnutrition. Infections and other medical conditions may also cause a child not to absorb nutrients adequately via his intestine, or they may increase the child's metabolic requirement and effectively make a "normal" meal inadequate. When other medical conditions co-exist with severe malnutrition in a child, the outlook for the child is grim. It has been shown that malnutrition is an independent risk factor impacting on higher mortality and morbidity in hospital-admitted children, increasing hospital stay and cost. [21] Malnutrition in children typically develops during the period from 6 to 18 months of age, when growth velocity and brain development are especially high. [22] So, feeding in the first year of life become a very important issue. We should not forget the popular saying, "you are what you

eat". It is particularly poignant in children as they would grow up to make what Nigeria would be in the future.

It is not uncommon for paediatricians to come across mothers complaining of their infants not feeding properly. Of course, feeding must start as early as possible after the birth of the child. It is highly recommended that feeding should commence within one hour of birth. [11,23] It has been shown by several studies that breast milk only is sufficient in the first six months of life. This has led to the defining of exclusive breastfeeding and its promotion. A lot of efforts have been put into promotion of EBF with the introduction of the Baby-Friendly Hospital Initiative in 1991. Ahmadu Bello University Teaching Hospital, Zaria, is a recognized and certified baby-friendly hospital. There are many benefits of EBF, some of them proven, some speculative; but all so important as to make the use of EBF highly recommended, if not enforceable for a developing nation in need of optimal adults. The beneficiaries of exclusive breastfeeding include the infant (obviously), the mother, the father, the community, and the nation. The benefits to the infant include provision of anti-infective components to guard against common killer conditions like diarrhoea, lower and upper respiratory tract infections. It promotes strong physical and emotional bonding between child and mother. It is the only natural food carefully designed for the newborn and in the early months of life, it is free, available whenever, wherever needed by the baby and always at the right temperature. There is no need for utensils and, therefore minimal or no risk of contamination of the baby's food. Breast milk reduces the risk of constipation in the first few months of life, it reduces the lifelong risk of conditions like obesity, type-2 diabetes mellitus, asthma, eczema. It is being speculated that it may protect against some childhood cancers and that it confers superior intelligence quotient in children. For the mother, exclusive breastfeeding promotes uterine involution, promotes family spacing by provide contraception during the period of breastfeeding, reduces the risk of developing breast and ovarian cancers. Breastfeeding is "cheap", it saves money for all stakeholders and helps keep the environment clean. Breast milk has no perfect substitute. It is a completely balanced diet able to provide all nutrients and calories in the right amount for six months. It is more complex than any meal one can think of as pictures 3 and 4 demonstrate.

Exclusive breastfeeding is defined as the feeding of a newborn, on demand, with only breast milk, and nothing but breast milk, for at least 8-12 times in 24 hours for the first 6 months of life. The use of physician-prescribed medication or supplements does not invalidate this definition. Sadly, studies have shown low rates of EBF in Nigeria and in Zaria. For instance, Audu and Ogala [24] found that the proportion of infants having EBF fell from 70.7% at 0-6 weeks of age to 14% at 5-6 months. Okolo et al., [25] working in JUTH, found none of 310 rural Savanna women practicing of EBF. Ogunrinde et al [26] found a despairingly low 47.4% EBF rate at 0-3 weeks of age and this more than halved to 20% at around 6 months. Reasons for this poor performance include the uncertainty surrounding the practice of EBF and the belief that giving water (or some other fluids, depending on culture) relieves pain, prevents and treats common cold and constipation, soothes fretfulness and quenches thirst. The situation is compounded by suggestion that some health workers may also promote this belief. [27,28]

Studies done mostly outside Nigeria had suggested that under various climatic conditions babies do not need supplemental water in the first 6 months of life to maintain water balance. For instance, in Lahore, Pakistan, it was demonstrated that babies were able to appreciably concentrate their urine when water restricted. The authors concluded that 2-4 month-old breastfed, healthy infants showed no signs of dehydration if additional water was not given during the summer month. In Benin, Edo State, Eregie showed that there was no significant difference in rates of micturition in exclusively and partially breastfed neonates. [29] When there is water deprivation there is a resultant rise in plasma osmolality and this would stimulate the release of the antidiuretic hormone leading to the formation of progressively more concentrated urine as the body attempts to preserve water. This increasing urine concentration may be detected by measuring the urine specific gravity as Ogunrinde GO & Alegbejo JA did and reported in 2005. [26] We set out to find out if supplemental water may be needed in the first six months of life in children living in the Guinea Savanna, our region of location. The study covered part of the dry season extending from March to September 1998 thereby capturing part of the dry season ending May of the same year. Meteorological data were collected from the

Meteorological Section of the Department of Soil Science, Institute for Agricultural Research, Ahmadu Bello University, Zaria.

The season was characterized by an average environmental temperature of 35.5 °C and a relative humidity range of 11.4% to 45%. The average temperature was 31.1 °C in the wet season and the relative humidity ranged from 76.6% to 87.6%. During the study period, 47 of 122 randomly selected infants aged less than 6 months were being exclusively breastfed, giving an overall EBF rate of 38.5%. Twelve of the remaining infants on supplemental water were also receiving other food items and were excluded from further analysis; so that only infants receiving either EBF or water and breast milk were studied.

An interesting finding to support the "baby is thirsty" issue is the observation that during the wet season 34 (53.1%) of babies received only breast milk. This proportion fell significantly to 28.3% (13 of 46 babies) in the dry season.

One of our findings was that while 47.6% of water-supplemented infants were delivered at home only 19.1% of EBF infants were similarly delivered ($p = 0.0039$). It is obvious that health workers are very important at promoting good health practices; even though at 19.1% water-supplementation rate among EBF infants there is still a lot of room for improvement in the education and work attitude of health workers.

We also found some evidence in the study to suggest that formal education of mothers goes a significant extent in promoting ideal infant feeding methods.

Grown-Up Children (Post-Infancy Children)

This is a big group of children. They can be categorized as those under 5 years (usually referred to as under-5), the pre-pubertal children (from 6 years to about 10-12 years) and the adolescents (from 10-12 years up to 19 years). These subcategories of children have very distinct biological, cognitive and social characteristics. But time and fate that determined my areas of practice and experience would not allow the distinction of these groups in my lecture. Let me say in the past two decades, a lot of attention had been put on the under-fives and we are presently seeing the positive outcomes of the many programs put in place to improve mortality and morbidity. Many more children are now surviving into the

second decade of life and programmes are now springing up to consolidate on these gains and build the foundation for a greater tomorrow. [30]

Unfortunately, the reduction in child morbidity and mortality has not been evenly spread with sub-Saharan countries witnessing a plateauing or reversal of progress. [31] The programmes aimed at reduction of childhood deaths and morbidity have been basically of two type: short-term, disease-specific initiatives and more general programmes of health care that are people-centred and community-based. [31] The disease-specific technology-dependent interventions have been met with both failures (malaria eradication programme) and successes (smallpox eradication, poliomyelitis eradication). The people-centred community-based programmatic interventions have their own difficulties arising from the wide areas needing intervention and meagre resources available. There is, of course, need for interventions to be scientifically sound. There are now efforts to coalesce these two types of interventions.

Diarrhoeal disease remains a significant health problem globally, coming second only to pneumonia as a cause of death in under-5 children. [32] In 2004, WHO and UNICEF jointly recommended the use of newly formulated low osmolarity oral rehydration salts and zinc supplementation in the treatment of childhood disease. [33] About 159-300 mg/kg/day of zinc is lost in diarrhoeal stools by children, and zinc supplementation has been shown to reduce duration of diarrhoeal episodes by 9-23% and stool frequency by 18-39%. [34,35]

According to UNICEF, it is not enough simply to expand the delivery of packages of low-cost, proven interventions: behavioural, institutional and environmental impediments that can impede access must also be addressed as part of the scaling up process. Families and communities are key to achieving the goals set for managing diarrhoeal disease by making the new recommendation routine practice in the home and health facilities. [33] A few years after the recommendation we decided it was pertinent to determine the degree of empowerment of home caregivers as far as the treatment of diarrhoeal disease was concerned. [36] We studied 4,386 caregivers. We noted a low literacy rate of less than 30% in both males and females. More than 70% of male caregivers were farmers while a significant higher proportion of females were housewives. Despite

the low literacy rates a good proportion correctly identified suggested causes of diarrhoea in children. Fifty-nine percent associated diarrhoea with suboptimal hygienic conditions, contaminated food and water. A further 10% linked diarrhoea with various infections including measles, malaria and human immunodeficiency virus infection.

Table I. Causes of diarrhoea identified by caregivers of under-5 children with diarrhoea

Suggested causes of diarrhoea	Frequency (%)
Contaminated food/water	649 (29.9)
Poor hygiene/sanitation	615 (28.4)
Teething	411 (19.0)
Infections	215 (9.9)
Inadequate breast milk/malnutrition	146 (6.7)
Malaria	121 (5.6)
Houseflies	11 (0.5)
Total	2168 (100.0)

In the study, less than 1% (2/4386) were able to correctly state the four rules of home management of childhood diarrhoeal disease; a majority of caregivers 56.7% were totally ignorant of the rules with the proportion being significantly higher in males. Seizing the opportunity of this lecture to spread the message, the rules are:

1. Give the child more fluids than usual. If oral rehydration salts solution is available this should be given to the child. Oral rehydration solutions, in addition to treating dehydration, can also prevent dehydration. Indeed, the prevention of dehydration should be the primary goal of the home management of childhood diarrhoeal disease. If ORS is not available fluids such as gruel, soup or rice water may be given. If the child is tolerating feeds well clean and safe water should be encouraged. In a child still on breast-milk breastfeeding should continue on a more frequent basis and each episode for longer period. If a child is on EBF ORS should be added. But note that a child on EBF hardly develops diarrhoea.
2. Give zinc supplementation. It has been demonstrated that zinc decrease the duration and severity of diarrhoea. It also boost the child's immune system and helps in lengthening

the interval between episodes of diarrhoea and promoting child health.

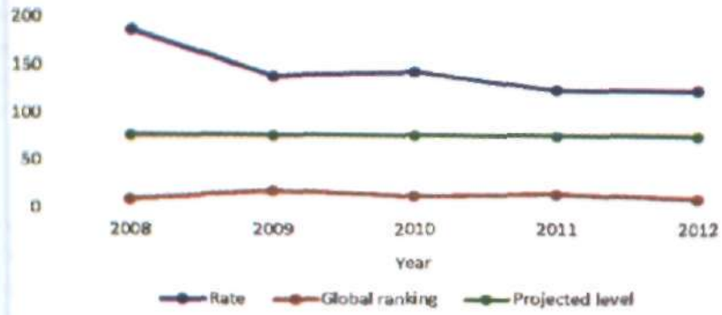
3. Continue to feed the child. There is a common and pervasive misconception in the country not to feed a child that is having diarrhoea. This is a very harmful practice as it deprives the child of the fluids, calories and nutrients needed to fight off infections
4. Know when to return or report to the clinic or health facility. When the child is passing many stools (say >5 times daily), child is very thirsty or has sunken eyes, has fever or a poor appetite, the caregiver should know it is time to seek medical advice.

The awareness of these rules should improve the outcome of diarrhoeal disease in the country and bring us to a situation when diarrhoea would become a nuisance, even in children, instead of a killer disease it is today. The proper implementation of these rules will go a long way in reducing the unnecessary, and sometimes harmful, treatment given to the children. In our study, we found 36.1% of caregivers gave antibiotics to their children with diarrhoea as first line treatment. This not only amounted to a waste of resources (as we know that 95% of diarrhoeal episodes are caused by viruses) but may contribute to worsening of the diarrhoea and incidence of resistance in medical cases where the antibiotics are actually needed. During the study, the caregivers were provided with 10-day supplies of dispersible zinc tablets to give to administer to the children. The rate of adherence to the 10-day regimen was 75.5% with male caregivers doing a better job at ensuring the children received the zinc supplementation. At an international conference in Liberia in 2009, ours was the only oral presentation on zinc supplementation in diarrhoea disease and it resulted in a recommendation on the use of zinc in the communiqué.

The international community in 2000, endorsed the eight millennium development goals (MDGs). These eight MDGs were established following the Millennium Summit of the United Nations

in 2000, following the adoption of the United Nations Millennium Declaration, to address the pervasive poor health status in mostly developing countries of the world. Each goal has specific targets and dates for achieving those targets. As far as reducing under-5 mortality rate Nigeria has been described as being off track. For Nigeria to meet MDG 4, the country must attain a two-thirds reduction in the U5MR from 230 per 1000 live births in 1990 to 76 by 2015. [11] The year 2015 is definitely around the corner and we are among the 10 countries with the worst U5MR global (Figure 3). There is urgent need to scale up activities aimed at promoting health of the Nigerian child.

Figure 3. Trend in under-5 mortality rate in Nigeria



Sickle Cell Anaemia

The Vice Chancellor, Sir, let me turn my attention to sickle cell anaemia, a disorder I have been treating for the past 17 years. It is a disorder that affect all age groups in childhood, including adolescents. Sickle cell anaemia (SCA) is a disorder of the haemoglobin contained in red blood cells that form the major component of blood, and essentially confers blood with its red colour. The major function of haemoglobins is to transport oxygen from the lungs to the body tissues where it is utilized in metabolism of nutrients, and to carry carbon dioxide in the opposite direction. Sickle cell anaemia is one of the many diseases of haemoglobin and they are referred to as haemoglobinopathies . There are basically two types of haemoglobinopathies: those that have altered structures

resulting in qualitative haemoglobinopathies; and those that have a reduced production of haemoglobin resulting in quantitative haemoglobinopathies. Sickle cell anaemia is an example of qualitative haemoglobinopathy. Sickle cell anaemia is a genetic disease and it occurs if an individual inherits the sickle cell genes, one from each parent. The gene is estimated to be present in one of every four Nigeria, [37,38] and this contributes to making SCA the commonest genetic disease in the country.

The sickle cell gene confers some protection against malaria in individuals with just one copy of the gene and a normal human haemoglobin gene. [38] These individuals are described as carrier of the sickle cell gene and are protected to some extent from the severe manifestations of malaria. It is likely that by selective pressure these individuals increased in number. This longevity is not duplicated in their offspring who tend to die at a young age. This pattern of increased longevity on one side of the coin and decreased life span on the other side has been described as a *balanced polymorphism*, an attempt to balance for gene loss that occurs with the early demise of children with phenotype SS.

Burden of Sickle Cell Anaemia

It is estimated more than 300,000 babies are born with severe forms of hemoglobinopathies worldwide each year. While 75% of all patients with SCD live in sub-Saharan Africa, Nigeria alone accounts for more than 100,000 new births every year, [39] representing about 2% of babies born in the country. In sheer numbers, Nigeria has the largest burden of sickle cell disorders in the whole world. [40]

The incidence and impact of SCA in Nigeria, and other developing tropical nations, is likely to grow in the future as improvement in hygiene and nutrition occur, and reduction in infections resulting in reduced childhood mortality allowing babies with severe haemoglobin disorder to survive long enough to present to health facilities for diagnosis and treatment. [41] As noted by Molineaux et al, apparently melancholically, "there is no other known inherited disorder present at such high frequency in a large population and of comparable severity as sickle cell anaemia in Africa." [42] They continued, "With the rising standards of living and

control of malaria, sickle cell anaemia will become an immense medical, social and economic problem throughout the continent." If the selective force of malaria were to be removed it would take many generations for the frequencies of these conditions to fall significantly. [41] With a trait carrier rate of about 25% and an estimated population size of 170 million people there would be approximately 42.5 million, mostly healthy, Nigerians having a copy of the sickle cell gene. This number of carriers far exceeds the population of every other African country and, indeed, of several of them put together. [40] There is a significant proportion of mortality in children with SCD. In Garki District of Kano State in 1979, for instance, 2.1% of babies born had SCA. This prevalence was maintained in the first year of life but fell drastically to 0.4% by 4 years and 0.05% over the age of 9 years. [42] SCA has major social and economic and psychological implications for affected children and their families. It places a heavy burden on the already strained health sector of the country. SCA may explain the phenomena of the "abikus" and the "ogbanjes" in certain part of the country. The psychological stress in families with repeated child death is better left to imagination.

Pathophysiology of Sickle Cell Anaemia

The acquisition of the genes means that the red blood cells in the child start synthesizing a qualitatively different type of haemoglobin called the sickle haemoglobin. All haemoglobins are soluble in water including the sickle haemoglobin. But when HbSS gives up its oxygen it becomes insoluble in water and starts to come out of solution in a process that is referred to as polymerization or gelling. This polymerization is not an instantaneous event and it takes a while for the process to progress significantly to cause disturbance in shape, rheology and function. When haemoglobin polymerization has progressed significantly in the erythrocyte, the cell changes shape into the characteristic sickle shape, become harder and less deformable, and becomes stickier and attaches to the wall of the blood vessel very easily. The abnormally shaped, less deformable and sticky red cells will now cause obstruction to the free flow of blood, not unlike the traffic situation occurring in the Kwangila area of Zaria on a daily basis. The interruption of blood

flow to parts of the body results in ischaemia and hypoxia which, if not addressed in a timely fashion will lead to more permanent injuries and loss of function. The most common manifestation of this process is the unpredictable and severe pains that sufferers of SCA experience, some at an unbearable frequency. The pain had been described as being far worse than that being experienced in the labour of childbirth. [43]

Fortunately, many of the red cells will make it back to the lungs long before there is extensive polymerization, acquire oxygen and revert back to the soluble state. However, the repeated cycle of sickling and un-sickling will ultimately damage the cells with resultant failure to come out of the sickled shape. These kind of cells are called irreversibly sickled cells. The cell membranes of these cell are damaged beyond what the body system can repair and they have to be removed from the body. The removal of these cells is much more than is seen in the removal of senescent cells of people with phenotype AA and results in two prominent features of SCA, namely pallor and jaundice.

One area of the body where it is specifically designed that blood flow would be slow is in the core of the kidneys. In the core of the kidney, called the medulla, is a countercurrent concentrating mechanism that helps the mammalian body preserve water with the passage of concentrated urine. This part is made up of parts of the loop of Henle (basically the tube in the kidney that transmit forming urine), the vasa recta (intricate blood vessels surrounding the vasa recta), both with fluids (glomerular filtrates and blood) flowing in opposite directions, and the surrounding supporting tissue of the kidney. There is extreme hypertonicity and extremely sluggish blood flow in this region; therefore, this is a very hostile condition to red cells containing sickle haemoglobin. They give up their oxygen as is expected, are subject to prolonged passage in a very hypertonic environment. They, therefore, become sickled and clog up vascular passages in the kidney which suffer irreparable damages.

Microangiopathic studies of sickle cell kidneys reveal gross lesions of the vessels of the renal medulla, with almost complete absence of vasa recta in sickle cell anaemia; and reduced number of vasa recta and loss of normal bundle architecture in sickle cell trait and sickle cell HbC disease. [44] The findings, according to the authors, suggest that the basic lesion in sickle cell nephropathy is

obliteration of vasa recta leading to the observed abnormalities in concentrating function.

A study carried out in Zaria and reported in 2007 explored an aspect of this school of thought. [45] We suspected that if, indeed, there was diminished ability to concentrate urine there should be an increased prevalence of bedwetting in children with SCA as was demonstrated in Lagos by Akinyanju and co-workers. [46] A case-control study of 360 children with SCA aimed to determine the prevalence and describe the pattern of nocturnal enuresis (bedwetting) in this type of haemoglobinopathy.

It was revealed that 150 (47.1%) of them, aged 5-12 years were bedwetting. This was significantly higher than the 17.7% (42 of 237) control children with nocturnal enuresis. The majority in each had never stopped bedwetting in their lives, so, they are considered to have primary enuresis. After the age of 84 months the prevalence of bedwetting in control children dropped rapidly to zero while it virtually plateaued in children with SCA, and dropped slowly after the age of 144 months. The oldest child with SCA and enuresis was 202 months (16 years and 10 months). It is known in normal children that males are more predisposed to enuresis than girls. This is confirmed in the Zaria study where 27 of 106 (25.5%) boys and 15 0f 131 (11.5%; $p = 0.008$) had enuresis. The reasons for this have not been established but slower developmental maturity and increased physical activities in boys leading to increased exhaustion at night are speculated. Even though the same pattern was observed in children with SCA the difference did not attain statistical significance. In 63 (42.0%) of the 150 enuretic children with SCA, the home caregivers perceived the bedwetting as being abnormal, even though only 6.4% attributed it to the effect of SCA. Among the caregivers of "normal" children only 9 (21.4%) thought of the bedwetting their children were experiencing as abnormal.

Table II. The caregivers adduced various reasons for the bedwetting in their wards.

Reasons for enuresis	Frequency (%)
Too much fluids	54 (19.1)
Too much sleep	51 (18.0)
Delayed development	34 (12.0)
Weather	33 (11.7)
Ill-health apart from SCA	24 (8.5)
SCA	18 (6.4)
Laziness	18 (6.4)
Familial	15 (5.3)
Don't know	12 (4.2)
Others	24 (8.5)

These reasons, which probably reflect beliefs and possible remedies, are worrisome. Obviously, majority would probably want to deny their wards adequate sleep and water. The withholding of fluids, which was being practiced by 9% of caregivers is alarming, as liberal fluid intake is at the cornerstone of the management of SCA. Of note is the fact that only three caregivers rightly thought that enuresis is a medical problem that requires the attention of health workers. The aetiology of enuresis is multifactorial although no definite cause has been established. It is possible that whatever the underlying causes are in the normal population, they are probably also operational in children with SCA. On top of these, children are known to develop hyposthenuria, an inability to adequately concentrate their urine, very likely the result of the virtual total destruction of their vasa recta. Children with SCA have a mean urinary output that is 53% greater than that of children with haemoglobin phenotype AA. [47] This additional factor may partly explain the greater prevalence of enuresis in them and also probably obliterate the known gender difference that happen in the "normal" population.

A maturational lag has been suggested as a cause of nocturnal enuresis and may be a factor in SCA-related bedwetting. Delay in pubertal changes is known in SCA and this may be related, in part, to SCA-related injury to the central nervous system. In our study, we did observe that children with SCA started walking at a significantly older age compared to controls. Motor achievement is

known to correlate with appropriate myelination and brain growth. Even though most caregivers of children with SCA thought enuresis as not being abnormal, the methods employed in amelioration may be harmful to the children. Withholding fluids in hyposthenuric children, for instance, may rapidly lead to significant dehydration with dire consequences. Scolding and/or spanking may add to the significant psychological burden being experienced by these children. It is also suggested that health workers involved in the management of children with SCA should be more proactive in the management of enuresis as fear of stigmatization of family and child may be a reason why they do not seek medical attention.

In a recent study, carried out in ABUTH, we demonstrated that 8.1% of children with SCA have significant bacteriuria, which is evidence of urinary tract infection in them. [48] The commonest causative organism was *Escherichia coli*, a major facultative inhabitant of the large intestine. The study also suggested that urinary tract infection is an important trigger of crisis as it occurred in 20.7% of children in sickle cell crises compared to the 2.2% in those that are well and said to be in steady states. Urinary tract inf ections in children with SCA, whether symptomatic or not, may ultimately lead to chronic kidney injury, compounding the direct insults of SCA on the kidney. All these data suggest the importance of closely monitoring kidney functions in children with SCA in order to facilitate early detection of kidney dysfunction and prompt institution of treatment designed to halt or slow disease progress.

Sickle cell anaemia, being a blood disorder, affects virtually all organs of the body to varying extent. We were able to show some mild liver derangement in children aged 1 – 14 years with SCA in Zaria in a recent case-controlled study. [49] We found that bilirubin (total, conjugated and conjugated), alkaline phosphatase levels were significantly increased in children with SCA. The derangements were mild apparently because only children with SCA who were in steady states were studied. There is need for further studies to enunciate the significance of the elevated aspartate alanine transaminases ratio noted in our study. It has been suggested that this elevation in ratio in the absence of non-alcoholic liver disease should point to the presence of cirrhosis. [50]

Table III. Liver function test profiles in children with sickle cell anaemia and controls

Liver function test profile (mean±SEM) among children with SCA according to age group										
Age group	*n*	TB (µmol/l)	CB (µmol/l)	UCB (µmol/l)	ALT (IU/l)	AST (IU/l)	ALP (KAU/l)	TP (g/l)	ALB (g/l)	AST/ALT
I (<5 years)	21	49.53±8.66	16.21±2.21	33.32±7.25	30.24±3.37	57.76±3.78	157.32±10.13	51.88±1.22	36.21±2.01	2.68±0.19
II (5-9 years)	20	46.92±5.13	16.12±1.65	30.80±3.96	24.87±2.91	54.58±5.23	163.47±15.70	53.16±1.35	37.84±1.71	2.70±0.15
III (10-14 years)	19	42.63±5.50	14.06±1.76	28.56±4.19	20.18±4.41	47.81±4.82	163.91±11.38	53.19±1.26	39.63±1.90	2.44±0.19
F-value		0.245	0.364	0.178	1.211	1.171	2.829	0.366	0.723	0.714
P value		>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	>0.05	>0.05

n: Sample size, TB: Total bilirubin, CB: Conjugated bilirubin, UCB: Unconjugated bilirubin, ALT: Alanine transaminase, AST: Aspartate transaminase, ALP: Alkaline phosphatase, TP: Total protein, ALB: Albumin, AST/ALT: De Ritis ratio, SEM: Standard error of mean

Liver function test profile (mean±SEM) among controls according to age group										
Age group	*n*	TB (µmol/l)	CB (µmol/l)	UCB (µmol/l)	ALT (IU/l)	AST (IU/l)	ALP (KAU/l)	TP (g/l)	ALB (g/l)	AST/ALT
I (<5 years)	21	21.67±2.14	4.71±0.83	17.77±3.43	25.53±4.67	56.47±4.85	116.92±12.29	76.47±2.06	37.15±0.91	2.47±0.20
II (5-9 years)	20	19.38±1.36	4.36±1.66	17.40±2.00	23.16±2.20	50.18±5.01	95.38±12.56	78.94±1.87	39.80±1.46	2.16±0.21
III (10-14 years)	19	17.91±1.96	4.27±1.07	13.55±1.35	18.13±1.54	37.91±5.42	149.26±19.83	78.36±3.62	38.64±1.28	1.84±0.12
F-value		0.799	0.056	0.307	1.598	1.642	4.087	0.292	1.418	1.230
P value		>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	>0.05	>0.05	>0.05
Post-hoc										
Grp I vs. II		-	-	-	-	-	*P*<0.05	-	-	-
Grp I vs. III		-	-	-	-	-	*P*<0.05	-	-	-
Grp II vs. III		-	-	-	-	-	*P*<0.05	-	-	-

Grp: Group, *n*: Sample size, TB: Total bilirubin, CB: Conjugated bilirubin, UCB: Unconjugated bilirubin, ALT: Alanine transaminase, AST: Aspartate transaminase, ALP: Alkaline phosphatase, TP: Total protein, ALB: Albumin, AST/ALT: De Ritis ratio, SEM: Standard error of mean

Blood transfusion forms an integral part of management of sickle cell disease and is also an established route of transmission of diseases, such as HIV, especially in underdeveloped countries lacking properly organized blood transfusion services. Blood transfusion may become necessary in children with SCA when they develop:

1. Severe anaemia secondary to malaria, other infections, haemolytic, sequestration and aplastic crises.
2. Vaso-occlusive phenomena like stroke, acute chest syndrome and priapism.

Depending on the severity and persistence of the above complications, blood transfusion may be used on a chronic basis to forestall recurrence of the complications.

We, therefore, screened 55 children with sickle cell disorder for antibodies of the human immunodeficiency virus, a topical blood transmissible infection that makes blood transfusion the more risky. Their mean age 68.5 ± 37.0 months. More than half (54.5%) had history of hospital admissions, mostly one admission each. We found almost half of the children with history of blood transfusion.[51] Incidentally, almost of these children with positive history had the blood transfusion outside Ahmadu Bello University Teaching Hospital. It is noteworthy that there are only two teaching hospitals in Zaria with the other one (Veterinary Teaching Hospital, ABU) not offering clinical services to human beings.

Sad as it may be, but fortunately, only one child with SCA had evidence of HIV infection. The infection was not acquired from the parents (they were seronegative 5 years after the birth of the child). The child had three blood transfusion, one of which was outside ABUTH. The same child had multiple intramuscular injections outside the walls of the teaching hospital. The low incidence of HIV seropositivity is unacceptable as it portend great risk in this group of children. Part of the solution would be to lower the prevalence of HIV disease in the nation, if not eliminate it, reduce the risk posed by the window period, and reduce the need and the use of blood in the management of sickle cell disease.

Blood donation and transfusion programme in Nigeria is mainly non-voluntary, remunerated, and family or family-

replacement dependent. This situation has been shown to pose significant risk of blood-transmissible infections, especially to those that cannot avoid blood transfusion in their treatment. A goal of making at least 80% of blood donations in Africa benevolent, voluntary and non-remunerated by 2012 was set by the Regional Strategy for Blood Safety of World Health Organization Regional Committee for Africa. A blood donation and transfusion programme coordinated at national or zonal levels as being advocated by WHO would probably go a long way to ensure adequate availability of high quality blood and blood products, especially in resource-limited settings. Nigeria is a signatory to the World Health Assembly Resolution, WHA 28.72 of 1975, which requires each member state to develop a nationally coordinated blood transfusion service, based on voluntary, non-remunerated blood donation. [52]

The management of sickle cell disorder should start as early as possible in life to effectively reduce morbidity and mortality. It was shown that early treatment with penicillin coupled with parental education resulted in significant reduction in adverse events in sickle cell disease. This had led to the introduction of neonatal screening and diagnosis of sickle cell anaemia, a concept that has not caught on in Nigeria probably due to lack of facilities and awareness of such rather than unwillingness to embrace it on the part of parents. It may also point to the unwillingness of policymakers and policy implementation to commit scarce resources to what might be thought of as a "no-problem" area. Whether we like to accept it or not, sickle cell disease has come to be with us for a long time to come. We have shown that as early as the second year of life significant reduction in height and weight occurs in children with SCD compared to those blood phenotype AA/AS. There is also evidence of zinc deficiency in children with sickle cell anaemia by the third year of life, and probably disturbed zinc metabolism and homeostasis.

There are many clinical effects of SCD in the body and a complete list is beyond the scope of this lecture. Suffice it to mention that because it is a haematological disorder and therefore affects virtually all bodily systems and organs.

We found in a study carried out in ABUTH, Zaria that children with sickle cell anaemia have reduced height and weight compared to children with blood phenotype AA/AS. [53] The deficits

in height and weight started early in life and tended to become more pronounced with advancing, probably a consequence of ongoing unabated insult. This could be a reflection of the disease severity, inadequate health-seeking practice or inadequate health care delivery.

There are many mechanisms speculated for the various manifestation of SCD, some are obvious and others not so.

We tried to ascertain if zinc deficiency existed in children with SCA and if the deficiency could account for some of the deficit in anthropometric measures noted in these children. [53] There are many body specimens that could be used to determine zinc deficiency. The most commonly studied specimen is the serum but this is known to be influenced by recent events, such as recent ingestion of zinc-rich foodstuff, such as beef, dairy products, spinach and nuts.

One of the richest store of zinc in the body is the red blood cell (erythrocytes) but it is thought that the zinc in these cells may not be metabolically available. We decided to use erythrocyte zinc since it is known that this storage accumulates over time. We felt this would be a more appropriate sample to look at as one of the parameter, height, being studied increases over a long time. We found that, aside the anthropometric deficits, children with SCA also had significantly lower erythrocyte zinc levels than children phenotype AA. We also found that whereas height and erythrocyte zinc concentration are positively correlated in children the AA phenotype no such relationship exist in children with SCA. Of course, we know that children with SCA are constantly destroying their red cells at a rate that occurs in other children with the AA/AS phenotypes. This would mean that a lot more zinc is circulating free in their plasma and therefore more likely to be excreted by the kidneys. Coupled with this is the known fact that the kidneys are also affected in SCD and therefore do not effectively filter the plasma with resultant loss of nutrients, including zinc, in the urine. It would, therefore, appear that children with SCA may need to have zinc supplementation to prevent such effect as growth retardation, increased susceptibility to infections and hypogonadism. Indeed, studies have shown that zinc supplementation resulted in improved growth patterns, increased affinity of the sickle haemoglobin for

oxygen without alteration of the Bohr effect, improved androgen levels in patients with testicular failure, and healing of ulcers. We felt there is need for further studies of zinc in SCD to determine the significance, if any, of the element in disease mechanism.

Clinical Manifestation of Sickle Cell Anaemia

Children with SCA usually suffer from episodes of serious illness described as crises. There are four of them, namely the vasoocclusive, the haemolytic, the aplastic and the sequestration crises. The most frequent is the vasoocclusive crisis, it results in severe painful episodes mostly requiring the attention of physicians, and is in its own class, the non-anaemic crisis, as it does not manifest with anaemia. The other three all give rise to anaemia by different mechanisms and are grouped together as the anaemic crises. The aplastic crisis is a particularly serious condition as the mechanism responsible for red blood cell production is temporarily shut down. The commonest organism responsible for this form of crisis is reported to be the Parvovirus B19. The virus is also implicated in the causation of the other three types of crisis in children with SCA.

In Kaduna State, we found 204 of 239 children aged 1-15 years had positive IgG to Parvovirus B19 giving a seroprevalence rate of 85.4%, with the highest seroprevalence rate in 10-12 year olds. [54] In Lagos, Iwalokun et al found 61.2% of individuals with SCA having IgG Parvovirus B19 antibodies and 64.2% non-SCA with the antibodies in their serum. [55]

In the United States of America, Smith-Whitley and coworkers found just 30% of their 633 children with IgG to the virus. [56] However, a significant number of their seronegative cohort subsequently seroconverted with an incidence rate of 11.3 per 100 patient-years.

The virus does not recognize socioeconomic borders as more than 80% of children in these groups showed evidence of previous infection with the organism. Apart from the transient red cell aplasia, Parvovirus B19 causes some other disease conditions in sickle cell disorder, including splenic and hepatic sequestration, acute chest syndrome, stroke and nephrotic syndrome.

Even though there is significant tissue damage in SCA at an early age pharmacodynamics of some drugs, at least pyrimethamine-

sulphadoxine, do not seem to be impaired to any significant extent as we showed in a recent study of children with SCA in Ile-Ife. [57] I will not bother you with details of that study as it was technical to a very good extent. Our study did show that children with SCA absorbed and metabolized this drug as would children without SCA. Pyrimethamine-sulphadoxine is an antimalarial fixed-combination antimalarial drug that is still useful in the prophylactically and curatively in Nigeria, even though it has been discontinued in countries like the United States of America.

Malaria is one of the most important public health problems in the world, particularly in the sub-Saharan region contributing significantly to childhood mortality and morbidity. [58] In Nigeria, it accounts for over 25% of under-5 mortality while children aged more than 5 years (about 24 million of the) have 2 to 4 attacks annually (Nigerian Federal Ministry of Health Report 2002). It is widely believed that malaria is the reason why we have SCA in the first place. People who are carriers of the trait, as well as heterozygotes of other inherited haemoglobin disorders, enjoy some protection from the severe forms of malaria. This protection is lost in those that have SCA. In actual fact, malaria is the commonest trigger for crisis in SCA. [59] So, not only do they suffer directly from having malaria, they also suffer the crises that malaria provokes in them.

Prevention of Sickle Cell Anaemia

Because malaria is an important issue in the disease process of sickle cell disorder, prophylactic or preventive antimalarial drugs form a cornerstone of management. Antimalarial drugs used for chemoprophylaxis include proguanil (Paludrine®), pyrimethamine (Daraprim®) and mefloquine. Proguanil (daily dosing) and pyrimethamine (weekly dosing) are the two commonest regimens. These prescriptions may not necessarily be effective due to poor compliance with or adherence to prescription; or to drug resistance. A reason for poor adherence include exorbitant prices of the drugs. In Zaria, for instance, we prescribe daily doses of proguanil for extended periods of time between clinic visits. I was reliably informed by a pharmacist that parents hardly buy supplies for more

than a week or two and do not usually come back for a refill. Yet, in the name of drug-resistant malaria new and more expensive antimalrial drugs are being developed and imported into the country. However, we have shown in studies carried out in Zaria that the careful and proper use of existing antimalarial drugs still offer considerable hope in the effective management of malaria.[60,61,62]

As pointed out earlier on, we should be seeing more individuals with sickle cell disorder in Nigeria as the prevalence of contemporary leading causes of childhood mortality reduces. This is bound to happen and is happening as a result of improvement in hygiene, nutrition and infection control. As a result of such demographic changes, the impact of inherited haemoglobin disorders is being felt all over the Indian subcontinent and in many parts of Asia, and this will undoubtedly be the case in sub-Saharan Africa as it undergoes a similar transition. [63] Evidence of our improving infection control capacity is the speed and the effectiveness with which the country resolved the Ebola issue with resultant certification of the country as Ebola-free by the World Health Organization on the 20th October 2014, about 4 months when it was brought into the country. As far as Ebola virus disease is concerned, Nigeria is the cynosure for the world, especially the Western countries trying to cope with the disease.

Is there anything that can be done to forestall this projected increase in sickle cell disorder? I am not sure we can do much. A much touted proposal is to put a programme in place to prevent individuals with sickle cell trait from marrying each other. One of my teachers, seated in this gathering, once asked me what my take on this was. I will repeat my answer. I do not accept this proposition because I believe it will create more problems for us as a nation. I believe that following through on this programme will create a social upheaval of seismic proportion. It will create a caste system in the country and establish more room for stigmatization. If such a programme is officially adopted, the typical Nigerian family with an HbAA son or daughter will most likely refuse the introduction of the S gene into the family lineage through marriage to a carrier of the trait. This is not to say young adults with the trait should not be advised on individual basis on the choice of appropriate marriage partners. Vice Chancellor, Sir, ladies and gentlemen, I am not against mass education on the subject matter but it should be done

carefully and sensitively. The solution to sickle cell anaemia, I believe, is to remove the "advantage" that persons with the SCA trait enjoy. It is desirable to remove this "advantage" as it will result in economic prosperity to the country. This "advantage" is malaria. There is strong evidence that the high frequency of sickle cell and α-thalassaemia genes have been maintained by exposure of population to malaria. [64] It is well established that malaria is one single vitally important cause of lack of development in Africa, Nigeria inclusive. It does so by hampering innate drive, reducing economic and educational output and development, and by extracting a heavy financial tag for treatment and prevention. [65] The perceived risk of contracting malaria has been suggested to negatively affect decisions related to investment, trade and crop choice and to impose a sizeable longer term costs by slowing economic growth in malarious countries and widening the gap between them and the rest of the world. [66] Malaria encourages capital flight from Africa.

Of course, we can decide to toe the line of Cyprus, as was attempted by a military governor in Oyo State. [40] In Cyprus, a country with a population of about 1.1 million (2010 estimation), there was a problem with β-thalassaemia that is inherited just like SCA and requires the inheritance of two genes. In an effort to reduce the incidence of newborns with two mutations associated with β-thalassaemia, and acting on a recommendation from the WHO in 1973, the Cypriot government established a compulsory carrier screening and counseling which was actively supported by the Orthodox Church of Cyprus. Although two carriers are free to marry, a research, that is yet to be published {Beck}, suggests that they are unlikely to do so anymore. According to the research the compulsory screening and counseling for thalassaemia is one of the most successful public health programs, but that it violates all existing ethical norms. It is obvious that this program is successful because it violates the bioethical rules formulated by the international agencies and associations of geneticists.

Among the Cypriots, the testing is basically compulsory, not voluntary. It is driven by an epidemiological approach to the population, not the individual as the fundamental unit. Counseling is directive, not non-directive. The result is eugenic, that is, fitted solely for the production of good offspring.

In this instance, an adaptive culture has ignored international bioethical norms – in the name of health and prosperity. [67] However, the programme met with initial resistance in the form of denial and falsification of results of phenotype screening. [40] Nigeria is a more complex country and I foresee a lot of problem if we decide to formalize screening for sickle cell trait.

Screening is usually targeted at two populations. Newborns can be screened for early diagnosis and intervention. It has been established that early commencement of medical care coupled with early education of parents result in fewer mortality attributable to SCA and improved quality of life. Of course, results of the screening at this age can be used for later reproductive decisions. Adolescents and young adults are screened basically for reproductive reasons. There is no direct evidence, however, that individual genetic counseling by itself significantly alters reproductive behaviour or the incidence of births of infants with haemoglobin disorders. [68] So, the question should be, can we improve our surroundings and environment so as to reduce the prevalence of adverse factors causing us so much discomfort in this country?

Cancers in Children

I cannot bring this lecture to a close without a brief mention of another area of interest. An area where progress in terms of meaningful research and development has been very difficult. I once did a presentation on childhood cancer and was amazed at the bewilderment of the audience at the mere thought of a child having cancer. Yes, children do have cancers. There are some significant differences between the cancers of children and those of adults, however.

1. Cancers in adults tend to occur in tissues or organ systems that have been exposed to one or more environmental insults, e.g. skin, lung, gastrointestinal tract, cervix and rectum. Those of children arise from such tissues as lymph nodes, blood, muscles, kidney and brain which are usually deep structure not in contact with the environment.
2. Compared to adult epithelial tumours, an extremely small fraction of paediatric cancers appear to be explained by known environmental exposure, such as ionizing radiations, chemicals and drugs used to treat cancers.

3. Unlike in adults where the risk of cancer increases with age, a relatively wide age range occurs in paediatric malignancies. There are two age peaks in children, early childhood and adolescence. During the first year of life, cancers described as embryonal tumours are the commonest. They become rarer as the child ages. Bone malignancies and Hodgkin disease and gonadal germ cell malignancies occur more frequently in the older child.
4. Children tolerate chemotherapy better and respond more to it than adults.

Cancer is a very important cause of childhood mortality, even in Nigeria. Its significance as a non-communicable disease is bound to rise, just like sickle cell anaemia, when we start to get the handle on communicable diseases.

We (Ogunrinde GO, Musa HH, Olorukooba AA, Musa H) have looked at the pattern of childhood cancer in Zaria, before the Haematology/Oncology Unit was established in the Department of Paediatrics. [69] The study was an audit of the first two years of operation at the permanent site of the teaching hospital in Shika. The clinical department moved from Tudun Wada to its present location in 2005.

Between 2005 and 2007 81 children (7.6% of childhood admission) with malignancies were identified, 74 (91.4%) had established histological diagnosis. The age distribution by sex revealed that virtually all affected children were aged between 1 and 12 years.

Table III: Sex and age distribution of children with cancers

Age (yrs)	Male	%	Female	%	Total	%
<1	1	2.6	0	0.0	1	1.4
1-5	18	46.2	15	42.9	33	44.6
6-12	19	48.7	18	51.4	37	50.0
>12	1	2.6	2	5.7	3	4.1
Total	39	100.0	35	100.0	74	100.0

In the years under study the four commonest childhood cancer in decreasing order were retinoblastoma, Burkitt's lymphoma,

acute lymphoblastic leukaemia and nephroblastoma. A mention must be made of the high rank of Burkitt's lymphoma. It is a tumour more commonly seen around 7 years of age, has been linked to the Ebstein Barr Virus and malaria, and therefore more commonly found in tropical Africa. It used to be the commonest childhood cancer in Zaria (Wammanda et al. unpublished). Another recent study in Zaria by Adewuyi, Ogunrinde and others confirmed retinoblastoma as the commonest childhood malignancy. [70] This apparently changing pattern became noticeable after the movement of the hospital to its permanent site in 2005. The reasons are not clear presently but it could be due to ongoing demographic transition. A report from Ilorin spanning 28 years of histological data showed Burkitt's lymphoma as the leading type of malignancy in children. [71] Incidentally, the authors did not disaggregate their data by year so it is unknown if there is a trend in the study. Other reports continue to show Burkitt's lymphoma as the commonest type of childhood, with retinoblastoma either second or third commonest. [72] A report from Enugu suggested the possibility of the increased incidence of nephroblastoma and retinoblastoma [73] while in Jos rhabdomyosarcoma was found to be commoner than Burkitt's lymphoma. [74] In our first series it was revealed that chemotherapy (the use of anti-cancer drugs) on its own represented 63.5% of treatment modality and was overall in 73.0% in combination with either surgery or radiotherapy. Unfortunately, only 5 (10.6%) of 47 children completed their courses of drugs. In the case of acute lymphoblastic leukaemia the course of therapy may last as long as two years.

The outcome for childhood malignancies was, and continues to be, poor. We were able to discharge, after the first few cycles of drugs, only 47.3%. There was an unacceptably high 29.7% hospital-based mortality. Eleven (14.8%) either left against medical advice or absconded. Overall, 74.2% of children that were discharged were lost to follow up. These are statistics that can be improved upon if studies are encouraged to find out the real reasons for the poor performance. One obvious reason is the advanced stages of cancer Nigerian children present with. Even studies would be needed to establish why parents present their children with strange symptoms late to the hospital. Then, we would be able to match internationally acceptable survival rates. As a result of the study we reported in

2004 we did recommend the establishment of an organized oncology unit in the Department of Paediatrics, staff training in oncology and funding of research and patient care. I am happy to report that there is a unit of Haematology and Oncology in my department, staff training has picked up. We are still having huge problems when it comes to contemplative research in paediatric oncology. Incidentally, our diagnostic capabilities are light years away from optimal.

Conclusion

The subspecialty of Paediatrics has a come a long way since its inception in the country in the 1960s. However, when compared to what is happening internationally, including in sister sub-Saharan countries, we have still a long way to go. There is need for intensive and focused manpower development, need for more contemplative and in-depth researches in order to give our children, the obvious future of our great nation, a better beginning in life. We need to make informed decision and this will depend on the availability of qualitative studies in Paediatrics.

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Picture 1



Picture 2



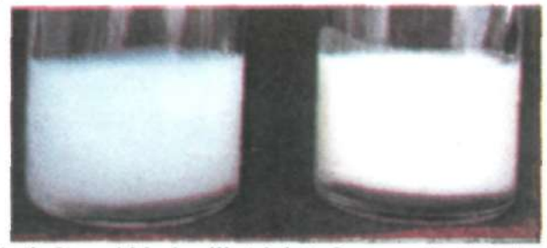
Picture 3



Colostrum (left) and matured milk (right)

Source: http://www.drpaul.com/breastfeeding/colostrum.html. Retrieved 2011-10-26

Picture 4



Foremilk (left) and hind-milk (right). *Source: Tonicthebrown*

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