# EVALUATION OF THE NATIONAL POLICY ON SCIENCE AND TECHNOLOGY IN NIGERIA: A STUDY OF NATIONAL RESEARCH INSTITUTE FOR CHEMICAL TECHNOLOGY (NARICT) AND INSTITUTE FOR AGRICULTURAL RESEARCH (IAR) ZARIA (1998-2008)

**BY**

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**Ph.D./ADMIN/07862/1993-94**

**FEBRUARY, 2011**

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**Ph.D./ADMIN/07862/1993-94**

**A Dissertation Submitted To The Postgraduate School, Ahmadu Bello University, Zaria, In Partial Fulfillment For The Award Of Degree Of Doctorate of Philosophy (Ph.D) In Public Administration.**

**Department of Public Administration,**
**Faculty of Administration,**
**Ahmadu Bello University, Zaria**
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**FEBRUARY, 2011**

## DECLARATION

I declare that the work in the dissertation entitled "Evaluation of the National Policy on science and technology in Nigeria: a study of National Research Institute for Chemical Technology (NARICT) and institute for Agricultural Research (IAR) Zaria" has been written by me in the Department of Public Administration under the supervision of Prof. Halidu Abubakar, Prof. Adejo Odoh and Dr Kola Obaitan. The information derived from the literature has been duly acknowledged in the text and list of references provided. No part of this project dissertation has been previously presented for another degree or diploma at any university.

……..... . …… …….

Name of student Signature Date

## CERTIFICATION

This dissertation entitled "Evaluation of the National Policy on science and technology in Nigeria: a study of National Research Institute for Chemical Technology (NARICT) and institute for Agricultural Research (IAR) Zaria" meets the regulation governing the award of the degree of Doctor of Philosophy (PhD) of Ahmadu Bello University and is approved for its contribution to knowledge and literacy presentation.

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Prof. Adejo Odoh Date

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Dr. Kola Obaitan Date

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Dr. S.B. Abdulkarim Date
Head of Department

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Prof. A.A. Joshua Date
Dean, Post Graduate School

## DEDICATION

This dissertation is dedicated first to Almighty God, for His immense guidance and love and to the entire members of my beloved family for their constant prayers and patience during this research work.

**ACKNOWLEDGEMENT**

I would like to first of all express my profound gratitude to Almighty God for giving me the ability, resources, understanding and patience to carry out this study successfully, I equally thank God for the journey mercies granted to me to all the places I went to in the course of conducting the study (collecting Data).

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Finally, I thank Miss Yinka for typing this work several times. I also thank my research Assistant, Mr. Peter John for their sacrifice during the field work.

**ABSTRACT**

This study is an evaluation of the National Policy on Science and Technology in Nigeria, focusing on NARICT and IAR (1998 - 2008). The study was carried out as a result of concern for Nigeria's over dependence on foreign products and neglect of her indigenous technologies. Despite the adoption of the national policy on science and technology in the country, Nigeria's dependence on importation of raw materials from overseas to keep the wheel of industry going persisted. The country is unable to create the necessary science culture in which the general public is made aware of the need to use scientific method in their daily operations. Nigeria lags behind in terms of technological development in spite of its array of manpower, natural and financial resources. The present situation tends to be even more pathetic as ordinary products like matches, tooth paste, soap and other minor products are imported into the country. These have resulted in Nigeria's overdependence on foreign products, neglect of her indigenous technology, over reliance on oil, declining foreign exchange and collapse of indigenous industries. Three hypotheses were formulated and tested for the study. The implementation strategy of the National Policy of Science and Technology does not add significant value to the performance of NARICT and IAR. Inadequate funding of research institutes such as NARICT and IAR contributes to the low quality of products in those institutes. The attainment of the objectives of the National Policy on Science and Technology is a function of the caliber of staff in the research institutes. Primary and secondary data were used. Descriptive and inferential statistics were also used to analyse the data. The main findings of the study were that government's allocation to research institutes is poor thereby affecting the performance of the institutes. Government allocation system is a failure as a result of poor management process of government resources. The government policy of direct disbursement of capital funds through e-payment by the Central Bank of Nigeria (CBN) to contractors is also not acceptable in the research institutes because funds meant for research and procurement are lumped together as capital funds in NARICT and IAR yearly budget allocation. In view of the findings of the study it was therefore recommended that all the research institutions should be well funded by increasing their allocations. The government should properly monitor the implementation of the policy.

## ABBREVIATION

| | | |
|---|---|---|
| ARCN | = | Agricultural Research Council of Nigeria |
| CAPL | = | Cotton and Agricultural Processor Limited |
| CGSD | = | Centre of Globalization and Sustainable Development |
| CSIR | = | Council for scientific and Industrial Research |
| COD | = | Committee of Directors |
| DCs | = | Developing Countries |
| EC | = | Emulsifiable Concentrate |
| FAO | = | Food and Agricultural Organization |
| FEDA | = | Federal Environmental Protection Agency |
| FMST | = | Federal Ministry of Science and Technology |
| GAS | = | Ghana Art Sciences |
| GDP | = | Gross Domestic Product |
| IAR | = | Institute for Agricultural Research |
| MRCN | = | Medical Research Council of Nigeria |
| NARICT | = | National Research Institute for Chemical Technology |
| NAERLS | = | National Agricultural Extension Research Liaison Services |
| NASENI | = | National Agency for Science and Engineering Infrastructure |
| NCSIR | = | National Council for Scientific and Industrial Research |
| NCST | = | Nigerian Council for Science and Technology |
| NEPAD | = | New Partnership For Africa Development |
| NSRCN | = | National Science Research Council of Nigeria |
| NSTDA | = | National Science and Technology Development Agency |
| NSTF | = | National Science and Technology Fund |
| OAU | = | Organization of Africa Unity |

| | | |
|---|---|---|
| RBDA | = | River Basin Development Authority |
| R&D | = | Research and Development |
| RNRDC | = | Raw Materials Research and Development Council |
| S&T | = | Science and Technology |
| SHESTCO | = | Sheda Science and Technology Complex |
| UNDP | = | United Nation Development Programme |
| ULV | = | Ultra-low –Volume |

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# CHAPTER ONE
# INTRODUCTION

## 1.1 Background to the Study

Development in real terms is the objective of every government and nation. The desire of every nation therefore is to be able to provide for the needs of its citizens in terms of goods and services, which in turn can only be achieved through the strategic utilization of science and technology. This is why nations which are considered to be developed scientifically and technologically are those that have the capacity to provide quality goods and services for their citizens. It is for the same reason that nations with low science and technology development are nations with the least capacity to provide for their citizens. For now, Nigeria is considered as belonging as belonging to the latter.

Nigeria is ranked as a developing nation, and the thrust of its national policies since independence can be summarized in one phrase: to develop the country. The objective of development is to provide food, housing, education, health, provision of infrastructure, transportation and communication creation of wealth through industrialization and efficient exploitation of natural resources,.

The Developed World is not static; it is developing and witnessing a continuing growth in its standard of living provided by an innovative industrial culture. An important aim of development is the acquisition of a measure of technological self reliance which is seen as an avenue for the achievement of self sustaining growth in the nation's socio-economic affairs.

Science and technology is recognized universally as fundamental to the over-all development of any nation. This explains the importance attached to technological development across the globe. African nations after their independence have

continued to strive to invest in science and technology, by introducing science oriented programmes in their educational curricula and science and technology policies, having realized its importance in turning the fortune of their nations around and as well, improve the standard of living of their citizens. Nigeria like any other developing country has not been left out in the process of transforming her economy through technology.

Science and Technology is fundamental to the economic and social growth of any nation, and what makes the difference between developed and developing countries is the level of technological advancement. According to Todaro (1977:77), the differences between the developed and the less developed countries, are attributed to differences in their various levels of technological development, and that the level of technology being used in the Developing Countries (DCs) accounts largely for the level of their underdevelopment.

According to Ohiorhenuan (1980:114), technology refers to the devices, method and process employed by man to mediate his relationship with nature. It consists of both the artifacts used and the knowledge behind production and consumption. To the author, the major difference between the developed and the less developed countries lies in the fact that countries of the former have a larger stock, both of technical knowledge and its embodiment in artifacts, while countries of the latter do not. This difference has been described as "technological-gap." Some writers have even gone as far as claiming that the economic distance (the income gap) between nations is largely reflected in the technological gap.

Before Nigeria's independence, scientific and technological researches were carried out and their findings published without efforts made at internalizing them practically. No tangible efforts were made to galvanize these efforts into coherent

activities geared towards promoting a sustainable economy (National Policy on Science and Technology, 1996). Also, most science and technology researchers in Nigeria are individuals and not corporately based. These individuals are not willing to take risk associated with commercializing research findings which require gradual development. They prefer rather to import turnkey projects from overseas.

In view of this situation, a policy framework within which science and technology can be planned and developed was formulated in 1986 by the Federal Government of Nigeria. The policy says:

> Science and technology shall form the basis of our development and shall influence our thinking. The philosophy of Science and Technology shall take cognizance of the economic and cultural milieu, recognize the human factor in science and technological capability of the nation, science and technological activities shall be planned to achieve its acculturation and use, through mass science education, technology transfer and acquisition, copy Creativity design and fabrication, and finally, charter a 8-11 root, based in the country's priority shall be followed". (National Policy on Science and Technology 1996).

In view of this, various parastatals and agencies were created to carry out these activities and implement the philosophy enshrined in the science and technology policy. The Federal Ministry of Science and Technology further designed a blueprint on Science and Technology Policy. The "blueprint on Science and Technology" is a guideline designed to create harmony in the quest for knowledge about the environment through research and the use of that knowledge to assure a better quality of life. The highlight of the blueprint includes a strategy for the systematic exploration and the exploitation of natural resources of Nigeria for the development and effective use of manpower, for the mobilization of the scientific and technological community, for development through provision of incentive, adequate funding of Science and Technology activities by both the public and private sectors of the economy, and for the inculcation of science and technology in the thinking and working process of

Nigerians. The policy summary as discussed by Adedoke (1987: 4) is as follows:

> Manpower was discussed under three overlapping sub-heads, educational system, mass movement and motivation. The policy trust is to emphasize at all levels of the educational system, and to create incentives for individuals engaged in science and technology.
>
> The provision of capital goods was treated under two headings, Machinery and equipment, and (b) financial inducement. The policy thrust and objective for both is to produce machinery and spare parts for establishing a strong technological base locally.
>
> The thrust and objectives of this section is the exploitation, processing and utilization of the nation's material development for local industries. This is to be achieved by maintaining an inventory of, exploring and exploiting the nation's mineral, water and agricultural resources for the production of various goods including drugs, vaccines, etc.
>
> The policy on energy as summarized is to develop, protect and optimally harness the nation's energy resources with the objective of providing cost-effective energy supply by rational and balanced exploitation of available energy resources.

Five directions of policy thrust were enunciated. These emphasized the need for Nigeria to apply only well proven foreign technology for its development project; utilize indigenous expertise, and create incentives for companies with local R&D facilities.

The policy thrust on environment is to ensure the development of a sound environmental culture nationally through the protection of the environment from man's harmful activities.

The policy thrust on environment is to ensure the development of a sound Environmental culture nationally through the protection of the environment From man's harmful activities For instance, the American government policy on science and technology lays emphasis on research in the universities with cooperation from the industrial sector.

The specific policy objectives according to key worth (1986) are to:

Produce highly competent manpower that would maintain American technological leadership in a completive world.

Enable American scientists and engineers challenges intellectual frontiers in the most important field of technology and engineering.

Stimulate productive partnership between scientists and engineers in all sectors of society partnership that are increasingly vital to the development of new technologies that will keep American industry competitive within the framework of globalization.

More so, European cooperation therefore is the key to the increasing international orientation in Germany approach to science and technology. The cooperation vital filed is being achieved through:

(a) The networking of European research and technological capacity building potentials.

(b) Intensification of cooperation between universities, research centres and industry, and

(c) Promotion of interdisciplinary and inter-industry projects that lead to

innovation.

In Nigeria, two of the parastatals established to implement this philosophy and tenets of science and technology policy are the National Research Institute for Chemical Technology (NARICT), Zaria and Institute For Agricultural Research, Samaru-Zaria with the mandates to undertake research and development work in the production of chemical and leather technology while the Institute For Agricultural Research undertakes researches to enhance farm productivity and agricultural product utilization. To this end, the research and development activities of NARICT are geared towards import substitution by processing and utilizing indigenous raw materials for industrial development. On the other hand, those of the Institute for Agricultural Research are geared towards processing agricultural technologies for enhanced crops production and utilization to achieve national self reliance in food and industrial raw material and have surplus for export.

Since the establishment of these parastatals, much financial resource has been sunk in to them. For example from 1998 – 2008, ₦3,758, 267, 624.51 and

₦ 46,1998,443.6 respectively has been spent on NARICT and IAR for annual budget plus infrastructure, machinery equipment, etc. This is geared towards ensuring their efficiency and effectiveness. (NACRT annual report, 199) However, these are yet to be achieved.

According to Halbrok (1992:262-266) a country like Japan which has very little of natural resources, but depends largely on raw materials from other countries, has through the efficient application of science and technology, transformed these materials into goods and services which dominate the world market, and is one of the most technologically advanced countries in the world. Japan has a self sustained economy and all its success – story is attributed to science and technology.

The goal of this study is therefore, is to evaluate the policy of the Federal Government of Nigeria with specific reference to the two parastatals chosen for this research, in order to appraise the success or otherwise of the policy.

## 1.2 Statement of the Problem

The rate at which the Nigerian industrial sector depends on imported input is alarming. Although efforts are geared towards import substitutions in the areas of science and technology, the anticipated outcome in terms of development is yet to be realized. Even the maintenance of the existing machinery meant for processing of products is being provided by foreign experts. While many countries of the world are in the second phase of industrial revolution in which computers, robots, micro-electronic, bio-technology and nuclear technology etc are common-place, Nigeria is still at the incubating stage of technological take-off. This is one of the reasons that national policy on science and technology was given the desired attention by the Federal Government of Nigeria in order to solve the problems of technological backwardness.

Science and Technology is a critical instrument of any nation, but its success depends very much on the environment. Unfortunately, Nigeria is yet to create the necessary science culture in which the general public is made aware of the need to use scientific methods in their daily operations. This situation has led to poor performance of NARICT and IAR in the implementation the policy on science and technology. Wanana (1990:18) opines that technology development in Nigeria over the years has been one of application of foreign technology to the local environment. This, according to Abubakar (1992:25) is a consequence of poor harnessing of science and technology for development.

Nigeria lags behind in terms of technological development in spite of its

array of manpower, natural and financial resources. It is only a technological power that records individual and national progress, and eventually becomes an economic power. Nigeria can only be restored to the path of socio-economic progress if it harnesses and develops its technological potentials to a level that would enable the country interact at the same level with the developed world.

NARICT and IAR are expected to work within the policy guidelines on science and technology; but the situation is still unsatisfactory. The present situation tends to be even more pathetic as ordinary products like matches, toothpaste, soap and other minor products are imported into the country. This has resulted in Nigeria's overdependence on foreign products, neglect of its indigenous technology, over reliance on oil, declining foreign exchange and collapse of indigenous industries.

The Federal Government of Nigeria deliberately pursued the policy on science and technology through institutions such as NARICT and IAR, by way of giving them incentives for research, personnel training, as well as infrastructural and material development. In spite of its efforts in this direction, no much success has been recorded. This study therefore seeks to examine the policy on science and technology in order to appraise its success or otherwise. The following are the questions designed to guide the research.

i to what extent have NARICT and IAR succeeded in providing indigenous raw materials for industrial technology in Nigeria?

ii To what extent have NARICT and IAR contributed to the development of indigenous raw materials in the area of chemical, leather and agricultural industry?

iii What are the inherent challenges that hinder the success of the policy on science and technology in NARICT and IAR?

## 1.3 Aim and the Objectives

### 1.3.1 Aim of the study

The aim of this study is to evaluate the contributions of the National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) to the promotion of science and technological development in Nigeria. This aim would be achieved through the following specific objectives:

1.3.2 Objectives of the study

i. To evaluate the extent to which NARICT and IAR have succeeded in providing indigenous raw materials for science and technology in Nigeria.

ii. To determine the extent to which NARICT and IAR have provided high quality chemicals, leather and agricultural inputs to the industry at affordable rates.

iii. To proffer solutions to the challenges and recommend new ways of improving the performance of NARICT and IAR within the framework of the National Policy on Science and Technology.

## 1.4 Hypotheses Tested

The following hypotheses were tested for the purposes of this research work.

(1) The implementation strategy of the National Policy on Science and Technology does not add significant value to the performance of NARICT and IAR.

(ii) Inadequate funding of research institutes such as NARICT and IAR contributes to the low quality of products in those institutes.

(iii) The attainment of the objectives of the National Policy on Science and Technology is a function of the caliber of staff in the research institutes.

## 1.5 Significance of the Study

From the literature available to the researcher, only a few researches have been conducted on NARICT and IAR to access their contributions to the development of science and technology in Nigeria. The researcher decided to examine this research institutes independently and compare the contributions made by each, so as to close this obvious lacuna in knowledge. However, this study shall attempt to provide the necessary link between policy objectives and their implementation in these research institutes. The reasons or causes of poor or partial implementation of policy objectives especially in the areas of science and technology are exposed in this study.

Nevertheless, decision makers in NARICT and IAR and other research institutes will find this piece of document instructive. Students of public policy will equally understand the techniques of policy analysis displayed in this study and adopt same for similar studies. Top government functionaries and policy makers are bound o benefit from the findings of this study. Therefore, the extent to which this study will be beneficial cannot be undermined. The significance of this study is thus summarized as follows:

(a) This study will help in examining the extent to which NARICT and IAR have achieved in providing indigenous raw materials for industrial technology in Nigeria.

(b) It will also assist the researcher to analyze the contribution of NARICT and IAR in the provision of high quality chemicals, leather and agricultural industry at an affordable rate.

(c) The study will also proffer solutions to the challenges and suggest ways through which these challenges can be overcome within the framework of national policy on science and technology.

(d) The study will as well help government to justify her expenses in line with the implementation of national policy on science and technology.

(e) The study will help students in this area of study to know how the problems concerning the national policy on science and technology can be solved.

## 1.6 Scope and Limitations of the Study

(a) This study covered the period of 1998-2007. 1998 marked a transition from military to civilian ruled and a year when Nigeria paid significant attention to the National Policy on Science and Technology. This year also marked a period when there was 100% budget implementation. This period is chosen as a significant period in the history of leadership that truncated the prolonged military rule in Nigeria. Besides, the period is sufficient enough to evaluate the National Policy on Science and Technology in Nigeria. However, the study is limited to national policy and the objectives of federal government on science and technology in NARICT and IAR.

(b) The study is limited to the National Policy on Science and Technology and the objectives of the Federal government on science and technology in NARICT and IAR

(c) The study also focused on socio-political system within the country which reflects the prime position of science and technology with regards to growth and development in science

and technology.

(d) This study covered only the resources budgeted and made available by government to implement the National Policy on Science and Technology as it relates to NARICT and IAR.

(e) The study is also limited to the performance of NARICT and IAR.

## 1.7 Definition of terms

*Inadequate Funding:* Refers to the amount of funds which government provides for NARICT and IAR which falls short of the budgetary requirements of the two institutes and which hamper the objectives for which they were established. In the case of NARICT for instance, government did not provide funding at all in 2003.

*Caliber of Staff:* This refers to the level of skills acquired through training by the staff of NARICT and IAR. High level manpower training is required for the attainment of the objectives of the two institutes. For instance, training up to the doctoral level will enhance the research competence of the staff. For instance, only 1.4% of NARICT staff were trained in 2007/2008.

*Government commitment:* refers to government's ability to meet its obligations to NARICT and IAR in terms of financial support and monitoring their activities. NARICT and IAR are government organizations that require financial support from government for them to be able to carry out their assigned functions.

*Evaluation:* Evaluation in this study refers to an appraisal of government's commitment to the achievements of the objectives for the establishment of NARICT and IAR in the realization of the objectives

on National Policy of Science and Technology in Nigeria.

*Attainment of objectives:* this refers to the extent to which NARICT and IAR have successfully achieved the Science and Technological objectives of the Federal Government of Nigeria, by contributing concretely to research and quality product availability in Nigeria.

*Performance:* performance in this study could be seen as the same as attainment of objectives. It also means the extent to which NARICT and IAR have been able to achieve the objectives for their establishment as stated in the National Policy on Science and Technology.

*Policy Implementation strategy:* this reefers to all the systematic means and steps taken by NARICT and IAR in the form of research, staff training, physical development and extension services, which cumulatively lead to the attainment of the objectives of the National Policy on Science and Technology.

# CHAPTER TWO

# LITERATURE REVIEW AND THEORETICAL FRAMEWORK

## 2.0.Introduction

This chapter reviews literature in the general area of technological progress or advancement with specific reference to Nigeria. The review also covers certain strategic case studies of nations which have developed science and technology policies around the world. The chapter ends with a section on the theoretical framework.

## 2.1. Literature Review

The importance of science and technology to the socio-economic development of any nation is great. Due to its role in the socio-economic life of any nation, there has been a considerable volume of scholarly research on the role or significance of science and technology to the development of society. Pointed among these works are those of Arrow (1962:87); Herrera (1978); Ohiorhenuan (1980:114); Krugman (1982, 1984, 1997); Pack and Westphat (1986); Spencer (1986); Schumpeter (1990); David (1991); Ray (1991); Wangwe (1993:16); Bwisa (1997); Downess *et al*, (1998); Achinivu (1999); Aluko-Olokun (1999); Gulma (1999); Schung et al, (1999); Oni (1999); Abubakar and Ajoku, (2001); Aina (2001); Barrow (2002); Belton (2002); Khalil (2002); Momah, (2002); Akpan (2003:22); Animalu (2003); Bolaji (2003); Abdullahi, (2004); Bamiro (2004); Kamilu (2004); Johnson (2006); among others.

However, the studies of these scholars have been as various as the weather. While some of the scholars have looked at the nature and relevance of public policy in general terms, others have paid attention to the evolution of science and technology in Nigeria. Yet, others have concentrated on the identification of problems that are associated with science and technology without specifically linking these problems to any policy of science and technology that is of interest to this research. As such, none of the studies encountered in the course of this research has been found to so comprehensively and analytically apply itself to the evaluation of the National Policy on Science and Technology in Nigeria with particular reference to National Research Institute for Chemical Technology and Institute for Agricultural Research (IAR). Thus, this research has become necessary in its aim to evaluate the National Policy on Science and Technology in Nigeria with particular reference to National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria, for ten years covering 1998-2008.

## 2.2 Historical Development of Science and Technology in Nigeria

Historical records had it that the first sets of research institutes in Nigeria were established during the colonial rule. The essence of establishing these institutions then was to boost agricultural output and thus provide adequate raw materials for industries in Europe (Aluko-Olokun, 1999, Barrow, 2002).

In 1898, the first agricultural research station was established in Ibadan and was called Moore Plantation. Thereafter, similar research stations were established in the then Northern Region at Samaru, Zaria and Umudike, Umuahia in Eastern Nigeria. The Department of Agriculture (or Moore Plantation) was later renamed Federal Department of Agricultural Research in 1954 (Barrow, 2002).

In the early 20$^{th}$ century, sub-regional research stations were established by the colonial administration with headquarters in Nigeria. These institutions or centres include the following:

- West African Cocoa Research Institute, Ibadan,
- West African Institute for Oil Palm Research, Benin
- West African Institute for Trypanosomiasis Research, Kaduna.
- West African Council for Medical Research, Yaba, Lagos.

Furthermore, the West African Research Office located in the then Gold Coast (now Ghana) had research centres in Nigeria. The research centres include the following: the West African Road Research Institute, the West African Timber Research Unit and the West African Rice Research Station.

Following independence of Ghana in 1957, most of the research institutions and centre became full-fledged national institutes in Nigeria. In 1964, the

Agricultural Research Institute Act was enacted by the parliament in Nigeria (Aluko-Olokun, 1999).

The institute was established to coordinate research activities in Nigeria as it relates to agriculture. Following the international conference on the Organization of Research and Training in Africa in 1964, Nigeria established a National Council for Scientific and Industrial Research (NCSIR) by Decree No. 83 of 1966. The Council was expected to act as an advisory body to government and as such, lack executive powers (Aluko-Olokun, 1999). Its mandate was quite narrow and therefore had structural weakness that prevented it from functioning efficiently. The real consciousness of the development of science and technology in Nigeria did not come into force until after the Civil war in 1970.

By the 1970s, concerted efforts were made to promote science and technology development in Nigeria. Within this period, the Nigerian Council for Science and Technology (NCST) was established by Decree No.6 of 1970 to replace the NCSIR (FMST, 1990). The Decree also, approved the establishment of four sectoral research councils, namely;

- The Agricultural Research Council of Nigeria (ARCN). established by Decree No.25 of 1971;
- the Medical Research Council of Nigeria (MRCN) established by Decree No.33 of 1971;
- the National Science Research Council of Nigeria (NSRCN) established by Decree No. 9 of 1973, and the Industrial Research Council.

The NCST was to coordinate research and development activities in the

country in fields such as agricultural science, engineering and technology, medical science, experimental sciences, environmental and social sciences. Aluko-Olokun (1999) observed that much of the development at this period was influenced by the activities of UNESCO.

It will be recalled that in 1974, UNESCO organized the first regional ministerial conference on S&T development in Africa called CASTAFRICA I which was held in Dakar, Senegal (Khalil, 2002). The conference identified and recommended among other issues, the need for African countries to formulate their Science and Technology Policy to guide national development, especially rural and industrial development.

In 1976, the government of Nigeria, in pursuance of its commitment to the resolution reached at the first regional conference, set up an S&T policy review committee which recommended two policy options, namely:

- the establishment of an executive agency to coordinate S&T policy; or
- the establishment of Ministry of Science and Technology with all the Research Institutes under it;

Based on the selection of the first option, the National Science and Technology Development Agency (NSTDA) were established by Decree No. 5 of 1977 with all the research institutes under it. With the emergence of this new institutional framework, the sectoral research councils and the NCST were dissolved. The National Science and Technology Development Agency (NSTDA) had no Minister and were chaired by the Chief of Staff Supreme Headquarters, Major General Shehu Musa Yar'Adua (Animalu, 2003).

By 1979, additional research institutes were established by this agency

bringing the total number to twenty-two made up of 18 agro-based, 3 industrial and 1 medical. NSTDA, in addition to supervising the research institutes, also, funded university-based research (Aluko-Olokun, 1999).

The search for an ideal national S&T structure did not end with the establishment of NSTDA. In 1980, with the emergence of a democratic government and with the-apparent realization of the importance of S&T to national development, President Shehu Shagari established the Federal Ministry of Science and Technology (FMST) and dissolved NSTDA through the Science and Technology Act No.1 of January, 1980. It was at this point that the first Minister of Science and Technology was appointed with all the complement of staff as well as its own budget. Within this period, government established specialized universities to focus attention on expanding the frontiers of knowledge in S&T in addition to training of high-caliber manpower required for the technological age. This period heralded the establishment of universities of technology and more polytechnics.

However, as government changed with the incursion of the military into governance and barely four years after its establishment, the new Ministry of Science and Technology was merged with the Ministry of Education as Federal Ministry of Education, Science and Technology. In 1985, following the overthrow of the then military administration of Major-General Muhamad Buhari, the Ministry of Science and Technology was once again made a full-fledged Ministry in 1986.

It was during this period (1986) that the first "National Policy on Science and Technology" was enunciated. The choice of scientists and technocrats in the running of the Ministry of S&T informed the radical change within this period (Animalu, 2003). Some of the pertinent issues for consideration include the establishment of "National Science and Technology Fund (NSTF) as a source

of funding for the implementation of the S&T policy. Also, the identification of the non-existence in the Federal Ministry of Science and Technology policy framework of an engineering infrastructure, informed the establishment of National Agency for Science and Engineering Infrastructure (NASENI) by Decree No.33 of 1992.

Uncertainty in governance of S&T in Nigeria manifested in the scrapping of the Federal Ministry of Science and Technology by late 1992. In place of the FMST, all research institutes except four were returned to their various sectoral Ministries. The Federal Ministry of Industry and Technology was created while the Sheda Science and Technology Complex (SHESTCO) came on stream vide Decree No.43 of 1991. The expected funding of S&T through the NSTF did not materialize (Animalu, 2003).

The Decree No.39 of 1987 which informed the establishment of the Raw Materials Research and Development Council (RMRDC) for the promotion of raw materials development was amended in 1992 and provided with a risk fund realized from the value added tax or surcharge on imported raw materials (Animalu, 2003). The Federal Ministry of Science and Technology was re-established in 1993 and since then it has maintained a stable functioning status till date.

## 2.3 Appraisal of Evolution of Science and Technology in Nigeria

One of the scholars who has done extensive research on the philosophy and significance of science and technology to society is Arrow. Writing on the way in which society progresses technologically and the state of technological development in developed and developing countries, Arrow (1962:87) cautioned:

> The way in which society progresses technologically and the spread of the program should not only be the preserve of the economist. Although economists can identify the main strings of progress, the pervasiveness and acceptance of such technological development in societies is not purely an economic matter. For example the spread of new knowledge depends on its rate of adoption and diffusion.

On the "invention or innovation activity of every society', Arrow (1962) observed that all societies are endowed, to some degree first with resources and potential supply. To him therefore, technological development raises questions of motivation, the willingness to assimilate new ideas and to break with custom and tradition, which impinge heavily on territory occupied by development sociologist; arguing that the relative importance of deterrent factors contributory to technology development and the spread of the progress itself will vary from country to country according to their stages of development and a whole complex of social and economic forces.

As can be seen above, Arrow's arguments on the way a society makes technological advancement are lucid and cogent. He has emphasised the collective and active participation of stakeholders for technological advancement to take place and the fact that [that] all societies are endowed, to some degree first with resources and potential supply for technological innovation. It can be surmised from his arguments that no one particular society in the world has a monopoly of technology. As cogent as these arguments are, they are not specific to any national policy on science and technology in any country, including Nigeria, thus the timeliness of this research.

The nature of science and Technology in the developing countries has also occupied the attention of scholars. One of such scholars is Herrera. In his

investigation of the nature of science and technology policy in the less developed countries, Herrera (1978) posited that "science and technology policy in the less developed countries is often not built on national project. The issue of national project is the exclusive preserve of the elites or bureaucrats." He perceived the national project as "a set of objectives to which the social classes which have direct or indirect-economic and political control aspire." He further argued that National project is different from national aspirations or ideals which represent the social expectations of the community. To him, these social aspirations can only be a national project when the "authorities in power' adopt and are able to implement them. He equally noted that, a country may not have an explicit science policy, but always have an implicit one by virtue of interaction of the social system at large and the science system. There is no doubt about the validity of Herrera's arguments. However, these arguments have rather ignored the basic preoccupation of this research.

Ohiorhenuan (1980) is another scholar that has done appreciable research in the area of science and technology. Technology, according to him, "refers to the devices, methods and processes employed by man to mediate his relationship with nature i.e. it consists of both the artefacts used, and the knowledge behind production and consumption" (Ohiorhenuan (1980:114). He contended that "the major difference between the developed and the less developed countries lies in the fact that the former has a larger stock, both of technical knowledge and its embodiment in artefacts, while the latter does not. This difference has been described as "technological-gap." Some writers have even gone as far as claiming that the economic distance (the income gap) between nations is largely reflected in the technological gap.

Relatedly, in a study carried out by the Centre of Globalization and

Sustainable Development (CGSD) of Columbian University, the general observation was that, the last two centuries have seen staggering advances of technology in fields such as communication, computation, transportation, material power agriculture, medicine and a host of others that are important to human well being. This advance of technology has been the primary source; more generally of the vast increases in productivity and per-capita income that many countries have experienced. But the advances in technology have been highly uneven, both across areas of human needs and across groups of people.

From Ohiorhenuan's submissions, it can be deduced that he appears to be more concerned with the technological imbalance that exists between the developed and the underdeveloped nations. The Columbian study has also toed Ohiorhenuan's line of argument with regards to some of the contributory factors to the lopsidedness that exists between the developed and the developing nations. However, these studies have not paid attention to the painstaking evaluation of any of the national policies on science and technology in the developing nations to pinpoint those areas of imbalance; thus, necessitating this research.

Krugman (1984) is a scholar that is more concerned with the ownership of knowledge and how this ownership impacts on developing nations. According to him, "knowledge is being increasingly privatized and the developing countries are being excluded. Many countries of the developing Nations find themselves increasingly unable to predict, let alone to regulate, the technology flow" (Krugman 1984). While the knowledge of these discrepancies is vital to the success of this research, such knowledge is not an end in itself thereby making this research inevitable.

The role of government in fostering industrialisation particularly in Africa has polarised scholars and institutions. While Krueger, Bakassa and the World Bank

(1997) have doubted the ability of the state to make sensible state intervention; others like Pack and Westphat (1986) have argued convincingly for selective state intervention in other contexts.

The arguments of these scholars have raised the questions among which is the issue of technological transfer. It is worthy of note that while these issues of state intervention and technology transfer are of importance to this research, the research goes beyond a sheer identification of those issues to an in-depth analysis of specific national policies on science and technology in Nigeria.

Another issue that has occupied the attention of scholars is the criteria for identifying industries which satisfy requirements for national policies on science and technology. A semblance of the criteria, which could be used to pick target industries, has been made in the context of industrialized economies. Spencer (1986) has given some of these criteria include: “industries which earn sufficient additional returns to offset the cost of subsides, industries with large and inflexible investment requirements, industries which use factors which are not so scarce as to result in the increase in the prices of such factor.”

In his contribution to the criteria-discourse, Schumpeter (1990) has given other factors that are worthy of consideration in striking a balance of technological growth between the advanced and developing countries as follows: (i) commercial intercourse and exchange of information through trade often referred to as "cultural diffusion process; and (ii)learning by doing" i.e. the accumulation of experience by workers, managers and owners of capital in the course of production, which enable production efficiency to improve on the future” and investment in human capital. As concrete as these submissions are, they have ignored the basic preoccupation of this study, which is the dispassionate evaluation of the National Policy on Science and

Technology in Nigeria with emphasis on National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria.

There are scholars that have seen the possibility of the developing countries gaining a competitive edge arising from natural conditions supplemented by technological change. One of these scholars is David. According to David (1991):

> There are economic activities in which the developing countries may continue to have a competitive edge arising from natural conditions supplemented by technological change; e.g. natural resources such as mineral and tropical products. The centrality of this technological change and innovation is supposed to enhance comparative advantage based on natural resource endowments.

It is in this context that the influence of technological capability on realization of the potentials in natural resources endowment in developing countries has been suggested. Indeed, technological capability and in particular prudent adoption of relevant new technologies applied on explanation, exploitation and processing various natural resources can make some difference in tapping the potentials of natural resources endowment. In the area of industrialization in the less industrialized economies, elevation of the role of technological change could contribute to improving the efficiency of the import substitution industries and improving international competitiveness in the export industries in the developing countries. Therefore, Ray (1991) suggested that "in order to cope with the changing patterns of market opportunities, it is important that the process of growing competitiveness be continuous and dynamic." As evidenced in their submissions, these scholars have also given room for more research by their failure to delve into the basic preoccupation of the current study.

Writing on the market opportunity indicators, Wangwe (1993:16) observed that there are indications that market opportunities for the non frontiers technologies

will continue to be presented by the challenges of world market conditions. For instance, the dominance of small firms in the apparel industry is explained by the rapid variation in style and colour requiring the production of small size lots and the ability to respond quickly to changing demand. The centrality of the market indicator component to this research is indisputable since science in general terms has to with socio-economic issues. This notwithstanding, Wangwe has not preoccupied himself with the wholesome preoccupation of this study, thus its validity.

After a dispassionate examination of the body of literatures on science and technology policy with emphasis on policy formulation and implementation, Bwisa (1997) quite correctly identified three types of policy subsystems consisting of "the policy framework, the institutional framework for policy implementation (Research Institutions) and the user's subsystem." He also harped on the need for a continuous interaction of the subsystems in order to create the necessary impact on national development. Apart from his identification of these subsystems, he has not made any effort to evaluate the various roles of these subsystems, not to talk of how each of these subsystems keys into particular national policies on science and technology which is the concern of this research.

Relying heavily on a United Kingdom government white paper, Downesss et al (1998) maintained that "cooperation between scientists, industries, financial sectors and government is critical in order to improve national competitiveness and quality of life. As a collaborative process technology policy design and implementation have been brought into much wider social issues like unemployment, environment crisis, health and housing in the developed countries. In line with their submissions, this study will also attempt an evaluation of the socio-economic impact of the National Policy on Science and Technology in Nigeria with a bias to National Research

Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria.

On the intricate nature of science and technology, Achinivu (1999) cited the inability of Nigeria to carry out effectively the rehabilitation or turn-around maintenance of the refineries due to lack of specialized skills and requisite spare parts as a case in point. He argued that rehabilitation engineering is beyond the classical design engineering. The rehabilitation engineer or team must be part investigator, part designer, part materials performance specialist and part construction inspector. This study will thus investigate the National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria with a view to unravelling the circumstances surrounding their operations.

Aluko-Olokun (1999) and Barrow (2002) have argued that first sets of research institutes in Nigeria were established during the colonial rule. According to them, "the essence of establishing these institutions then was to boost agricultural output and thus provide adequate raw materials for industries in Europe." Now that Nigeria has gained independence and is in a position to make her policies, the current study will try to establish if Nigeria's research institutes are still designed to serve the economic interests of other countries.

Lamenting on the technological backwardness of Nigeria, Gulma (1999) observed that though Nigeria is well endowed with human and material resources, including technologists and engineers, it is however, deficient in technology. This implies that the human and material resources are not properly utilized since the strategic infrastructure established after Nigeria's independence were all based on foreign technology. Granting the fact that the country had limited manpower in the

area of science, engineering and technology at the time of independence, however, as time progressed, the approach to development through the utilization of local human resource did not improve. This according to him is a major setback of science and technology in Nigeria. One of the concerns of this study will be to evaluate the extent to which this limited manpower ha impacted on the performance of these institutes.

In order to arrest the manpower challenge, Oni (1999) has argued that "European countries recognized the importance of collaboration between industry and the university and between the university and the larger society." Apart from drawing attention to the need for collaboration between the ivory tower and the social tower in European countries, Oni has not said whether such a need has even been felt in Nigeria.

Talking about the underpinnings of the German approach to science and technology, Schung et al (1999) averred that "the German approach to science and technology is influenced first of all by its own domestic technological demands of the national economy and secondly by its place in the globe and in the context of the European Union (Schung et al, 1999). These conditions are both important and mutually influencing. This study will see these conditions have been incorporated into the Nigerian approach to science and technology.

The inability of local researchers and development partners to carry out researches that are supportive to the emerging industries or even adopt technologies developed abroad contributed to the current declining international competitiveness of the local industry has attracted the attention of Abubakar and Ajoku (2001). Canvassing for the active participation of local researchers and development partners in the budding industries, they argued that: "At this time, it was necessary, in fact,

desirable to create a local research and development system capable of efficient interaction with the production sector. This, however, did not come through and … contributed to the current low level of industrial development of the country" (Abubakar and Ajoku, 2001). These submissions appear to be reasonable. Their veracity, will therefore, be established in the course of this research.

The definition of public policy has attracted the attention of Aina (2001) and Belton (2002). According to Aina (2001), a public policy is a long series or more or less related choices including decision not to act made by governmental bodies and officials. This definition implies clearly that a policy is more than a decision. It also involves a series of *a* specific decisions relating to choices and that, the ways in which choices are made interrelated. Belton (2002) on the other hand, has seen public policy as a broadly defined statement of intentions by specific general procedures and guidelines for authorization and for action. This implies that, a public policy is basically a framework and it is a framework with a clear procedure and guidelines, which authorize what to do or not to do and which give backing and course of action.

Aina (2001) and Belton (2002) have offered valid definitions of what a policy; what it sets out to achieve; and what informs its formulation. Apart from the above elucidations that these definitions have made, the authors have not domesticated their definitions of a policy using any government policy including those that are the concern of the present research, thus, the relevance of this research.

There have been scholarly arguments about the procedural effectiveness of Science and Technology policies in Africa. Thus, when in 1974, UNESCO organized the first regional ministerial conference on Science and Technology Development in Africa called CASTAFRICA I which was held in Dakar, Senegal

(Khalil, 2002), certain recommendations were made in this regard. The conference identified and recommended among other issues, the need for African countries to formulate their Science and Technology Policy to guide national development, especially rural and industrial development.

In line with this recommendation, a former Permanent Secretary in the Federal Civil Service Chief Philip Asiodu noted "that in Nigeria, the iron and steel complex was planned and executed without basic information on quality, characteristics and quantity of available primary raw materials." This information gap delayed the commencement of the project from 1970-74 to the 1980s. Similarly, Momah (2002) argued that the cement industries were established without adequate geological investigation which informed the wrong choice of technology in some projects.

A reading of these revelations about the iron and steel complex, and the cement industries compels one to carry out sister evaluative assessments of National Policy on Science and Technology in Nigeria. That is why this study is devoted to an evaluation of the National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria.

In recent years the term "innovation system" has come to be used to describe the complexity that has come to be associated with the processes of technological and scientific advancement on the one hand, and the consideration of institutions involved as well as the public policies that are shaped by the institutional division of labour. In response to this complex synergistic interplay that exists between the institutions and the public policies that birth them, Akpan (2003:22) deduced that, of course, the real issues are not in-between but elsewhere. Social development today is determined by the ability to establish a synergistic interaction between technological innovation and

human value, leading to a new set of organizations and institutions that create positive feedback loops between productivity, flexibility, solidarity, safety, participation and accountability in a new model of development that could be socially and environmentally sustainable.

Akpan further observed that, it is easy to agree on these goals, but difficult to develop those that could be socially and environmentally sustainable. The developed nations for a long time have learnt and made enduring, continual and sustainable policies that naturally have helped them break through the course of history but that has not been the case with developing nations. Though he spoke of the social and environmental unfriendliness of policies in the developing nations, Akpan failed to expatiate on those policies that are cantankerous to the social and environmental wellbeing of the developing nations. That of course, was not his focus. Hence, this research has again found its relevance.

In 1976, the Nigerian government, in pursuance of its commitment to the resolution reached at the first regional conference, set up a Science and Technology policy review committee which recommended two policy options, namely:

- the establishment of an executive agency to coordinate S&T policy; or
- the establishment of Ministry of Science and Technology with all the Research Institutes under it.

Reporting on further developments, Animalu, (2003) wrote:

> Based on the selection of the first option, the National Science and Technology Development Agency (NSTDA) were established by Decree No. 5 of 1977 with all the research institutes under it. With the emergence of this new institutional framework, the sectoral research councils and the NCST were dissolved. The National Science and Technology Development Agency (NSTDA) had no Minister and were chaired by the Chief of Staff Supreme Headquarters, Major General Shehu Musa Yar'Adua.

Apart from giving us insights into the historical development of science and technology in Nigeria, Animalu has failed to carry out any assessment of any science and technology police that is the subject of this research.

Bolaji (2003) has done considerable work on the nature of national policies and concluded that policies that are national in character are usually made up of three major components. These according to him (2003) are:-

1. **Legislation:** A policy comes into being with a legal declaration of intention especially through an act of parliament. This act or legislation defines the intentions of the policy, itemize the goals to be achieved, provides guidelines on how these are to be achieved and also specifies the institutional framework for actualizing the goals and objectives. The institutional framework is more or less the same things like administrative structure and process for actualizing the policy goals and objectives. Sometimes, the legislation may suggest ways by which the implementation of the policy could be funded.
2. **Regulations**: These are the second part of policy which are usually supplement to legislation or act of parliament. They provide the guide for the detail of the policy often identifying incentives or penalties which are to assist in the implementation of policy and usually, these regulations are bulky and technical in their languages and most are considered not to be users friendly.
3. **Instruction**: These are usually given by people with the supervisory capacity and instructions are usually at the administrative or operational level, of policy implementation, they can be written sometimes or they are verbal but whether written or verbal institutions

are usually applicable in the context of institutional framework for the implementation of policy.

In a similar vein, Abdullahi, (2004) has averred that national policies can be broadly classified into three namely:

i. D**omestic policy**: This is a type of broad policy that concerns action by public officials in order to respond to demands or satisfying the needs of citizens within the national context. These policies can be either regulatory or they can be distributive in nature or they can be re-distributive in nature. Regulatory domestic policies usually seek to exert control or influence over individual or groups in the national context from the perspective of satisfying the needs and aspiration or demand of citizen's e.g. regulatory policy is policy on crime or environment or on commerce or with regards to consumer's right. Distributive policies on the other hand, are related to provisions of services by government .to individuals and groups in the national context. These may include policies which seek to address health, education, and housing or subsidies to farmers in Agriculture. All these examples of policies embody benefit which government gives to .citizen in order to distribute benefit or wealth creation or development in societies. They are policies, which are aimed at addressing what government defined as the needs of the citizens.

Redistributive policies only differ slightly with distributive policies in the sense that, they are aimed at addressing or bridging or solving inequalities in the society. E.g. policies for poverty eradication or job creation or welfare benefit either to the aged or to the less privileged

or disadvantaged group in the society.

2. **Foreign policies**: As broad category of national policy are usually aimed at defining the relationship between a country and its neighbours or other nations in the international system. Generally, these policies are made in the context of what is defined as national interest. It consists of concern about survival of the nations or about image or prestige in the international system. Foreign policy can be either regulatory or distributive, only in very rear instances can foreign policy is viewed as re-distributive. Example of regulatory foreign policy includes: trade sanctions or embargo, political or economic, which a country may impose in its relations with other nations in the international systems. Example of distributive foreign policy includes foreign aids which a country may give to another whether military or economic etc.

3 **Defence policy**: This deals essentially with what is called national security matters which usually have a bearing on how to deal with threats to peace and stability, whether these threats emanate from external or internal sources. Some people see defence policy as on aspect of foreign policy because there is sense in which it can be said that defence policy are also aimed at dealing with problems of national survival. There are two types of defence policy:

1. Strategic, which deals particularly with re-deployment of nations military resources in order to deal with perceived threats.
2. Structural in the sense in which they give emphasis to how defence of territorial integrity and survival of a nation can be arranged in

> relative or in relation to the priorities that the nation identify. Example of this aspect of defence policy may focus on what the size of the armed and security forces in a nation should be and what the extent of expenditure or allocation of national resources to these military and the security structures should be as priority in relation to what has been allocated to other areas of national priority.

While the above clarifications (Bolaji, 2003 and Abdullahi, 2004) are illuminating, they are too general and have, as such, failed to address the basic concerns of this research.

The negative effects of poor policy formulation have attracted the attention of Nigerian policy scholars. Bamiro (2004) observed, regrettably that, the LNG, a joint venture investment was bedevilled by the low intensity of technology transfer to Nigerians by the Joint Venture partners. He wondered if there was any strategic plan to build up the requisite technological capabilities to exploit the enormous gas reserves so as to achieve optimal national development and ensure future turn around maintenance. The inability of government to come up with a national strategy for ensuring "local content" in the choice and adoption of technology for implementation of national projects has affected the technological capability development of the country. Bamiro's concern is with the proper planning of our national policies in order to achieve planned development.

Development planning is widely accepted as a means of bringing about development. These plans are products of coordinated thought, efforts, estimates and assumptions which influence, guide and regulate the development process (Kamilu, 2004). The ability of government to control these processes, therefore, makes a significant difference depending on the type of policies it formulates, how faithfully

the policies are implemented and the premium it places on evaluation. Kamilu (2004) itemized the nature and characteristics of public policy as follows:-

- ✓ Public policies are shaped by public interest (even those policies that are privately inclined)
- ✓ It is political – it is a product of political process and guided by political consideration.
- ✓ It is guided by the desire to maximize public benefit, macro benefit consideration.
- ✓ They are a product of well-conceived procedure and methods, which though may be lengthy and cumbersome. It means to ensure the efficacy of such policy.
- ✓ Public policy in terms of scope is universal (broader). It has universal applicability, appeal and effect.
- ✓ Public policy is authoritative and as a product of well designed procedure and method. It is legitimate because it is coined and designed by those that have the authority to do it either elected representatives or their appointed agents.
- ✓ Public policy also guided by ethnical consideration i.e fairness, transfer of resources, spread of services etc.

In all the literature reviewed in this study, the holistic evaluation of the National Policy on Science and Technology in Nigeria with emphasis on National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Zaria (1998-2008) has not been carried out. It is in this regard that the researcher is compelled to evaluate the National Policy on Science and Technology in Nigeria paying particular attention to the National Research Institute for Chemical Technology (NARICT) and Institute for

Agricultural Research (IAR) Zaria for a decade from 1998-2008.

## 2.4 Science and Technology Policy in Europe and the United States of America

Shapira and Kutilmann (2000) have carried out a comparative study on science and technology policy in the United States of America and Europe. They submit that a number of analysts have argued that policies for research, innovation and technology in advanced economics are shifting into a new phase of development. For example, Caracostas and Muldar (1998) suggest that since the end of World War II, the research and innovation policy framework has gone through two major stages: first, from an emphasis on basic science and defense needs to, second, a more recent focus on key technologies and industrial objective. Now, a transition to a third phase is underway – with a thrust on innovation and societal goals. Others have advanced similar ideas, with general agreement that traditional models of science and technology policy have been superseded. In their place, new paradigms have emerged that typically involve more complex and iterative perspectives on the RIT process, emphasize innovation, competitiveness, and societal development, and stress performance in meeting broadened policy goals (Kodama 1991, Freeman 1991, Tassey, 1992, Crow, 1994, Galli and Teubal 1997).

According to Shapira and Kuhlmann (2000), a series of factors have driven these changes in intellectual and policy in technology intensive sectors such as electronics, computing, and new generation vehicles. Simultaneously, new geographical clusters of technology capability have developed and more intense transactional economic and technological linkages have been forged. Shapira and Kuhlmann argue that it is no longer possible for individual countries to dominate

major industrial and technological sectors (in the way the United States, did in the 1950s and 1960s). Nor is it realistic to expect that strength in science alone will "automatically" result in strong industrial performance. One consequence of this has been a shift in science and technology policy in recent years in the US and Europe, with relatively less pure science more attention to applied research and a greater emphasis on diffusion (Branscomb and Keller, 1998, Caracosta and Muldar 1998). New patterns of industry consortia, university- industry linkages, public –private partnership, and multi-national research programmes such as those sponsored by the European Union or the Intelligent Manufacturing Systems project. Rapid developments in information exchange and knowledge transfer, and the pace of progress in science and technology itself have stimulated the sponsors and performers of research to review their priorities, approaches, and institutional structures. Included in this has been a rethinking of governmental roles, not only in terms of partnerships to speed diffusion, but also in establishing improved framework policies for research and innovations and in prioritising research areas and targeted technologies.

Examples of the new policy approaches at the Federal level in the U.S. include the development of the Advanced Technology Program, the Manufacturing Extension Partnership and the United States Innovation Partnership (Shapira, Kingsley and Youtie 1997). Comparable programmes have been developed in Europe and in other advanced industrial economies (Chang, 1998). States in the U.S.A. have also increased their investments in technology development programmes in recent years, including university non-profit centres, joint industry university research partnerships, direct financing grants, incubators and other programmes using science and technology for economic development (Coburn and Berglund, 1995;

Berglund, 1998). In Europe, member states of the European Union have generally increased budget shares allocated to research policy over the last decade, while the European Union has itself mounted several waves of applied research and technology initiatives within the context of successive framework programmes (Caracosta and Muldar, 1998), meanwhile covering a small but increasing share of national RIT activities. (Reger, and Kuhlmann, 1995; Laredo 1995; Georghiou et al, 1993).

These developments in policy paradigms and governmental roles have been accompanied by changes in the context for evaluation. In Europe, since, the 1980s various national governments forced the evaluation of effects and socio-economic impacts of RIT programmes (Georghiou 1995; Meyer-Krahmer and Montigny 1989 1989). German Federal Ministries for research and technology, for economic affairs,) supported independent impact evaluation studies for many major RIT programmes. Seeds for an emerging "evaluation culture" (Becher and Kuhlmann 1995; Kuhlmann, 1995). New efforts to reform the public sector and to control its cost have led not only to the promotion of partnership to leverage resources, but also to a greatly increased concern with efficiency and performance measurement (Osborne and Gaebler 1993, Shapira, Kingsley and Youtie 1997). The Federal Government and a majority of US states are now pursuing performance-based management and budgeting systems – and as such systems are increasingly being applied to RIT policies and programmes. For example, one recent survey of US state science and technology programme found that most of states have some type of method for collecting performance data on conducting a programme evaluation. Yet, despite greater "data" collection, few states have well-conceived science and technology policy evaluation plans. Activity reporting, client survey data, and informal client contact are the most commonly used evaluation methods, more systematic evaluation approaches are less common.

(Cozzens and Melkers 1997). Only in part is this due to lack of funding or interest; there are also complex issues about how best to apply evaluation methodologies to assess the often diffuse and indirect effect of technology promotion policies.

The desire for enhanced measurement of RIT policies and programmes is also evident at national and, to some extent, international levels. In the United States of America, federal pressure on RIT sponsors and performers to demonstrate the relevance and value of what they do has grown. This is due to not only to new legislative requirements, for instance through the Government Performance and Results act, or even tighter budget constraints, but also to heightened political debate about the focus public investments in scientific, technological, and economic competiveness in the new era. A case in point is the US Advanced Technology Programme (ATP), a controversial federal partnership programme with industry to develop and commercialize high-risk enabling technologies to support US competitiveness. The ATP aims at long-term projects that are not only risky but are likely to have diffuse spill-over. Nonetheless, Ruegg (1998) observes that the ATP "has met nearly continuous demand for measures of impact of the programme since the day it was established." Yet, the ATP is not an isolated case. In other federal programmes, as well as in comparable RIT programmes in Europe, at the European Union and national government level, the demand for evaluation has increased.

However, significant "supply-side" issues remain in the development and application of appropriate methodologies to meet the increased demand for RIT measurement and evaluation. RIT policies pose many measurement challenges for evaluators. It is usually difficult to fully assess all benefits and costs of RIT programmes related spill-over, counter-factual explanations and 'soft' institutional and learning effects. Such evaluation challenges increase as RIT programmes

become more complex in efforts to address multiple objectives, involve partnership consortia, or to promote the capabilities of research networks and clusters. Again, the ATP case is illustrative. Extensive efforts to improve evaluation methodologies have been required, only some of which have so far come to fruition. Moreover, even where comprehensive evaluation strategies are developed, issues remain in the communication and use of results. A major issue is how to better link evaluation strategies with programm learning and continuous improvement, as well as evaluation's more conventional application to program justification.

The RIT policies of the European Commission provide another illustrative case; evaluation has been a legislative requirement for European RIT programmes since the early 1980s. The European Commission services have acquired a solid experience in the field of research evaluation since then. For the first three framework programmes (FPs), more than 70 programmes evaluations and more than 40 supporting studies have been carried out, all in all involving more than 500 European experts. For the 4$^{th}$ FP, the changing S and T environment and the increasing pressure for timely independent evaluation has led to the implementation of the current evaluation scheme which is based on two activities for each programme, a continuous monitoring with the assistance of experts external to the Commission services, and with multi-annual intervals a five year assessment conducted by external experts. While this scheme fulfilled its duties, the continuously increasing need to better demonstrate the usefulness of a European public RIT policy call for an enhanced measurement of results and impacts. The next 5-year assessment and the forthcoming 5$^{th}$ Framework Programme offer the necessary opportunities. A set of "criteria" has been developed ("European value added" and the subsidiary principles in relation to national efforts, social objective, economic

development and scientific and technological prospects) that calls for a further development of the evaluation practice, concerning in particular , a shift towards broader socio-economic aspects of the programme. Changes require a redesign of the assessment mechanisms and related ways of data provision currently available: it is likely that a new, comprehensive programme assessment scheme will be implemented.

## 2.5 Science and Technology Policy in Ghana

China, South Korea, India, Malaysia and Singapore and a few other countries, followed their footsteps and have also successfully applied science and technology to transform their economies. The very rapid economic transformation that has taken place in the Republic of Korea for example in contrast to Ghana is generally attributed to the greater success of the framework in acquiring and using the knowledge and innovation based on science and technology. Yet at the dawn of independence in 1957, Ghana also nursed the dream of rapid social and economic development using knowledge and tools derived from S and T. In a speech which the founding Prime Minister of Ghana, Dr. Kwame Nkrumah delivered at the last meeting of the old legislative assembly on the 5th of March, 1957 he spelt out clearly vision of rapid development based on the application of science and technology. He said:

> Our whole educational system must be geared to producing a scientifically minded people. Because of the limitations placed on us, we have to produce, of necessity, a higher standard of technical education than is necessary in many of the most advanced countries of the Western world. I believe that one of the most important services which Ghana can perform for Africa is to devise a system of education base at its university level on concrete studies of the problems of the tropical world. The university will be the coordinating body for education research, and we hope that it will eventually be associated with research institutes dealing with agriculture,

> biology, and the physical and chemical sciences which we hope to establish (McWilliam and Kwamena-Poh, 1975) cited by Kwame Akyeampong 2007)

This vision drove the impressive institutional arrangements made within a few years after colonialism ended to apply research, science and technology to national development. A National Research Council was established in 1958 to operated full-time scientific research institutions to study and develop appropriate technologies to support the country's development. A Ghana Academy of Learning, a learned society, was established in 1959, which became the Ghana Academy of Sciences in 1961. In 1963 the National Research Council merged with the Academy which assumed responsibility for ten full-time research institutes and projects whose programmes were directly related to the nation's economic and social development.

In 1966, following the overthrow of Dr. Nkrumah changes were made to the Academy which became the Ghana of Arts and Sciences (GAAS) and the Council for Scientific and Industrial Research (CSIR) which in its present form was re-established in 1996 with 13 research institutes. Over the years more scientific and technological institutions were established. These include the Ghana Atomic Energy Commission, Environmental Protection Agency, Noguchi Memorial Institute for Medical Research, the Ghana Standard Board, etc.

Along the research establishments and government agencies and central to their functioning, are the universities which perform the important task of training the high level human resource to run and manage them. The University of Ghana began in 1948, as the University College of the Gold Coast, the Kwame Nkrumah University of Science and Technology began as the Kumasi College of Science and Technology in 1951. The University of Cape Coast started in 1961. As of 2009. Ghana has seven public universities, and 25 small private universities with that

number of universities as well as ten polytechnics, and over 500 senior high schools, 23 technical institutes, and a large number of informal sector where most artisanal skills training take place, Ghana can be said to have a substantial education and training capacity for human resource development in science and technology. Inadequate staffing, laboratory and workshop facilities have however, limited the capacity of all these education and training institutions to produce the quantity and quality of high level scientists and technologists, the middle level technicians and artisans.

With the creation of the Ministry of Environment, Science and Technology in the Third Republic, as the Ministry of Industry, Science and Technology, the promotion, management, coordination and harmonisation of science and technology policies were finally placed in the mainstream of Ghana's government machinery. Currently, the status accorded science and technology in Ghana is low, Science and Technology have a low priority rating in the eyes of the policy makers and managers of the nation's resources. This has resulted in the inadequate allocation of the nation's budget to science, technology and innovation. Also without industries to use the talents and skills of bright young men and women who opt for science at school, their attraction is for medicine and related disciplines rather than the hard sciences of physics, mathematics, technology and engineering based professions. Inadequate support for science and technology is manifest in the country's resource allocation to science and technology which has fluctuated between 0.3 and 0.5% of the Gross Domestic Product (GDP). This allocation is well below the target of 1% of the country's GDP prescribed at the summit of the African Heads of State of the Organisation of African Unity (OAU) in 1980 under the Lagos Plan of action and adopted by the UN as a critical means if realizing the goals and objectives of the New

Partnership for African's Development (NEPAD), Korea, Singapore, and Taiwan spend as much as 2% of GDP" on science and technology.

In spite of the post-independence push to create the current science and technology capability, Ghana unlike many of the more successful economies transformed by science and technology, there has been no definitive and prescriptive National STI policy document to define policies and prioritise investment. A National Science and Technology Policy to commit government, the productive sector of the economy and the science and technology sector workers, to set targets for production, processing, and also research and development. The existing Science and Technology policy was adopted as a national document in 2000 providing a broad framework for defining goals and objectives for the application and development of science and technology for socio-economic development. The policy was however not implemented. More importantly, advances in science and technology with wide applications, such as innovations in ICT and internet applications as well as emerging trends in biotechnologies with great potential such as nanotechnology among others underscore the need for Ghana to formulate a more comprehensive and vigorous approach to build a more modern scientific and technology capacity.

Meanwhile, competitive pressures on the national economy are enormous. The global trade environment which is dominated by rapidly emerging technologies and processes is gradually becoming threatening to local African enterprises. Climate change and its consequences in terms of food crisis and threats to human welfare are affecting Ghana as it is doing to the entire world ecosystem. However, the opening up of trade opportunities in the global markets in general and the mounting requirements of the World Trade Organisation Treaty on Technical Barriers to Trade

(Uruguay Rounds of Talks) pose both opportunities and risks to the developing economy of the country. Local enterprises can still be competitive in the global trade environment with enhanced innovation and scientific content in their operations in all areas, in this regard, Ghana as a matter of urgency has to make urgent policy decisions to harness science and Technology policy in the development process.

## 2.6 Development of Science and Technology Policy in China

Mu Rongping reports that since 1999, China began to transform government – owned research institutes into enterprises with a view of strengthening national innovation system, especially the capability of technological innovation in enterprises level. At the national level, the first batch of 242 research institutes affiliated to former State Committee for Economic and Trade and the second batch of research institutes affiliated to other Ministries have been transformed into enterprises by the end of 2001.

The transformation of the 242 R and D institutions has very important demonstration effect for transforming other scientific institutions. About 5,000 local government-owned such institutions have been transformed into enterprises. In 2003, the Central Government in China began to transform state-owned public welfare research institutions, but in different way to some extent. For example, the research institutes were also transformed into nonprofit organizations with more government budget.

However, the transformed research institutes still play very important role in promoting industrial technology progress. They took over lots of projects of the national science and technology programme and provide technology service for enterprises. For example 242 transformed research institutes received 676million yuan RMB by took over the projects of national science and technology programmes,

and profit 1.1 billion yuan RMB with 9.1billion yuan RMB of sales revenue in 2002.

In recent years, enterprises have gradually become principal parts in the technology innovation. The technological innovation capability of enterprises has been increasingly strengthened according to new results of evaluating 302 technology development centres of large enterprises.

Universities have become significant base for knowledge generation, diffusion, technology innovation as well as commercialization of science and technology achievements. Universities account for about 17.5% of total full-time equivalent research and development personnel, while research institutions and large and medium –sized enterprises account for 19.9% and 41.0% of total full-time equivalent research and development personnel in 2002. The universities, research institutions and large and medium-sized enterprises account for 22.4%, 30.1% and 35.8% respectively in 1998, which indicates that more and more research and development personnel concentrate in enterprises.

Universities account for 10.1% of total research and development expenditure, independent research institutes account for 27.3%, enterprises account for 61.2% in 2002, the share of the universities and the independent research institutes is 10.4% and 42.5% respectively in 1998, which shows that enterprises have become principal parts of innovation.

Chinese Academy of Science (CAS) has significantly strengthened its competitiveness by implementing the "knowledge Innovation Programme". The number of SCI papers published by CAS surpasses the Max-Plank Society (MPG) surpassed in 2000, and 4109 units more than MPG in 2003, while the number of SCI papers published by CAS in top twenty journals of each research fields increases faster than that of MPG and CNRS in 2003, from 20% of MPG and 17% of CNRS in

1998 to 53% of MPG and 52% of CNRS in 2003, which shows that the gap in quality of published papers tend to be smaller. Besides, CAS accounts for more than 50% of published papers by Chinese in the science and the nature, 54% of that in the top twenty journals of each research fields.

Mechanism for cooperation between industry, universities and research institutes has gradually been established. Enterprises engaged in 90% of all projects of the National Science and Technology programmes for key technologies research and development, 80% of large enterprises have established cooperation partnership with universities and research institutes.

The transformation of the 242 research and development institutions strengthens the linkage between research and development and production, and the technological innovation capability of enterprises to some extent. The share of scientists and engineers in state-owned independent research institutions decreased from 31.5% of total in china in 1991 to 21.5% in 1998. The share should be much lower than before as soon as all state owned independent research institutions have been transformed. The fact that the share of research and development persons in state-owned independent research institutions has been gradually decreasing also implies that more and more research and development personnel join in industrial sectors.

The transformation of the 242 research and development institutions is propitious to exploiting human creativity of researchers and to building up indigenous technological innovation capability in the transformed institutions. On the one hand, the transformed institutions are forced to build up indigenous continual innovation capabilities due to increasingly drastic market competition so as to develop competitive hi-tech products and to win the competition; on the other hand, the fact

that technology and management expertise participate, together with other production factors such as capital, labour and land in distributing the economic returns of the transformed institutions must prompt researchers to exploit new technological resources, and to make full use of them.

The transformation has changed the research model of state-owned independent research institutions from government-oriented or following foreign research organization to market-oriented. Although state-owned independent research institutions are encouraged to run business for about 20 years, the performance of researchers is still evaluated according to academic indicators such as academic papers and experimental results, not the economic value of research results. The purpose for research and development institutions to run business is to make money so as to survive, not to meet the technological demands of enterprises. As soon as these state-owned independent research institutes are transformed into enterprises, to maximize profit, the nature of enterprises will push transformed independent research institutes to develop what the market needs and then quickly commercialize them. Besides, the transformation itself also provides many opportunities for the combination of technology and capitals, which enable transformed research and development institutions to enlarge their market share.

As a developing country, China has to face the challenge of further strengthening its infrastructure in science and technology and so as to promote productivity, innovation capability and social welfare. Besides, China also has to make structural adjustment and institutional reform so as to improve the magnitude and efficiency of science and technology output, enhance the role of business sector in research and development and innovation, and foster the diffusion and utilization of technology throughout the economy.

Science and technology infrastructure has been improved gradually since 1990s. During the past ten years, China has put lots of money for big science project, large experiment instruments and science and technology documents/data bank. The sharing mechanism for science and technology infrastructure has been highly emphasized in science and technology policy measures. Besides, the Chinese government is making long term planning for science and technology development, with a view of supporting national, social, economic development. The first stage of the strategy research for the long term planning ranges from macro strategy research, to key science and technology assignments, and science and technology input and policy environment.

The macro strategy research concerns the general strategy for science and technology development, the science and technology system reform and national innovation system, while the key science and technology assignments concern the manufacturing, agriculture sectors, the energy, resources and oceanic technology, the transportation and communication and the modern service sectors, cover the issues related to the population and health, the public security, the eco-reconstruction, environment protection and recycling economy, the city development and urbanization, the strategic hi-tech and industrialization, the national defense and the basic science issues. The main purpose for studying key science and technology assignments is to determine science and technology priority. Science and technology input and policy environments concern the equipment and infrastructure for science and technology research, science and technology talents, science and technology input and its management, policy for science and technology development, innovation culture and science popularization and regional science and technology development.

The expenditure for science and technology in China has increased steadily

since 1998. The expenditure for research and development reaches 128.76 billion yuan RMB in 2002, about 1.23% of the GDP. There are 3.22 million science and technology personnel in 2002 in China, including 2.17 million scientists and engineers, about 22.7% and 39.8% higher than that in 1995.

The sales of new products account for 13.2% of total revenue from the sale of products in 1999, and 16.1% in 2002. The expenditure on purchase of domestic technology in large and medium-sized enterprises of China accounts for 1.63% of expenditure on technical renovation in 1999, 2.88% in 2002, while expenditure on technology absorption accounts for 2.14% of expenditure on technical renovation in 1999, 1.72% in 2002.

It is possible to deduce from the discussion above that certain salient characteristics distinguish the polices of science and technology in the countries reviewed and Nigeria.

It is similarly plausible to deduce that the implementation of the respective science and technology polices in those countries differ from that of Nigeria in certain significant ways. Little wonder that the outcomes or impacts of science and technology policy in Nigeria are not the same as in those other countries.

For instance, while there is no adequate interface between research institutes and the organized private sector as well as investors in Nigeria, there are systematic efforts in the countries examined liked the U.SA, Germany, China and Ghana. In the U.S.A. for instance scientists and inventors` patents are patronized by the business community and investors who fund such research efforts.

The same situation prevails in Ghana where research institutes interface with private sector in the funding of research in science and technology and the marketing of the products of such research efforts.

In addition, in the U.S.A. and Europe Universities, non-profit centers are established to complement the efforts of research institutes. This also exists to a limited extent in Ghana, China and Germany but non-exist in Nigeria.

Similarly, in the United States of America, there are initiatives that provide a direct link between researchers and the industrial sector. This is handled through the joint industrial University research partnership which ensures that research is tailored towards the specific needs of the society. It also ensures that the products of researchers'' efforts are properly marketed and rewarded which will in turn galvanize more research efforts.

It could also be deduced from literature that in Europe, member states of the European Union have generally increases budgetary allocations to research efforts of their science and technology institutes. This has generally led to a boost in research in those countries. Similarly, in U.S.A. and Ghana, there have been conscious efforts to increase funding through increase budgetary allocation for the implementation of those countries` science and technology policies.

Conversely, in Nigeria, there has been dwindling budgetary allocation for the implementation of government`s science and technology programmes

In the countries of Europe and the use monitoring and evaluation of science and technology polices and activities are done within the framework of the legislature, where as in Nigeria, the same is not the case. While, the legislative requirement for monitoring ensures that polices are strictly adhered to in the former countries, in the latter, as a result of lack of rigorous and close monitoring, the science and technology policy of Nigeria has generally been adrift.

Generally then, it could be asserted that for the policy on science and technology in Nigeria to achieve its purpose, that must be adequate interface between

research institutes and the organized private sector in terms of defining the focus of research, funding and commercialization research outcome.

Similarly, budgetary allocation to science and technology in Nigeria has to be boosted in order to ensure that the research institutes, such as IAR and NARICT have adequate funds to carry out their research activities.

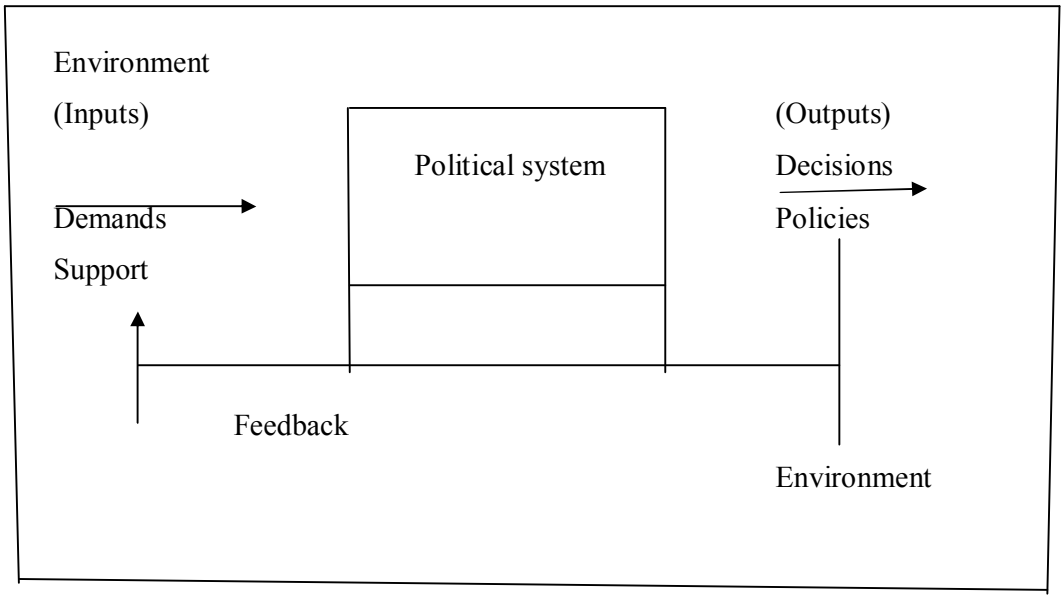
In addition to fact the research institutes is already established, it will ideal, as it is done in the Europe and U.S.A. to establish University based on non-profit which will focus on specific research areas in science and technology in Nigeria.

## 2.7 Theoretical Framework

The system theory is one of the management theories for organizational analysis (Basu 2004). The general systems theory originated in a movement aimed at the unification of science and scientific analysis. Therefore, the term 'system ' is defined as a complex whole, a set of a connected things or parts (Basu 2004) a system is a collection of interrelated parts which receives inputs acts upon in an organized manner and thereby produces certain outputs.

According to Bari (2005), a model of political system was first developed by David Easton who is regarded to be the pioneer of systems theory. The political system is an open system that takes inputs from the society or environment in form of demands and supports for particular policies and decision. These inputs are processed by the political system that results to output. The outputs flow back into the environment through a feedback mechanism, giving to fresh demands or agitations.

**EASTON MODEL OF SYSTEM THEORY**




Source: Bari, 2005

David Easton has characterized demand as the raw materials out of which finished called decision are manufactured. In addition, he has described supports as the energy in the form of actions or orientations enabling the political system to convert the demands into authoritative decisions and policies. These demands may rise from any source such as the people, politicians, experts, administrators, opinion leaders among others. Easton in Beri (2005) made elaborate classification of demands, supports and output. He sub-classified demands into four.

(i) Demands for allocation of goods and services

(ii) Demand for the regulation of behaviour

(iii) Demand for participation

(iv) Demands for communication.

Supports are also sub-classified as follows

(i) Material support

(ii) Obedience to law rules and regulations

(iii) Participatory supports

(iv) Paying attention to government communication and respect to public authority, symbols etc.

The outputs are the decisions and policies. They are sub classified into four.

(i) Extractions which may take the form of tribute, taxes or personal services

(ii) Regulation or behaviours

(iii) Allocation or distribution of goods and services

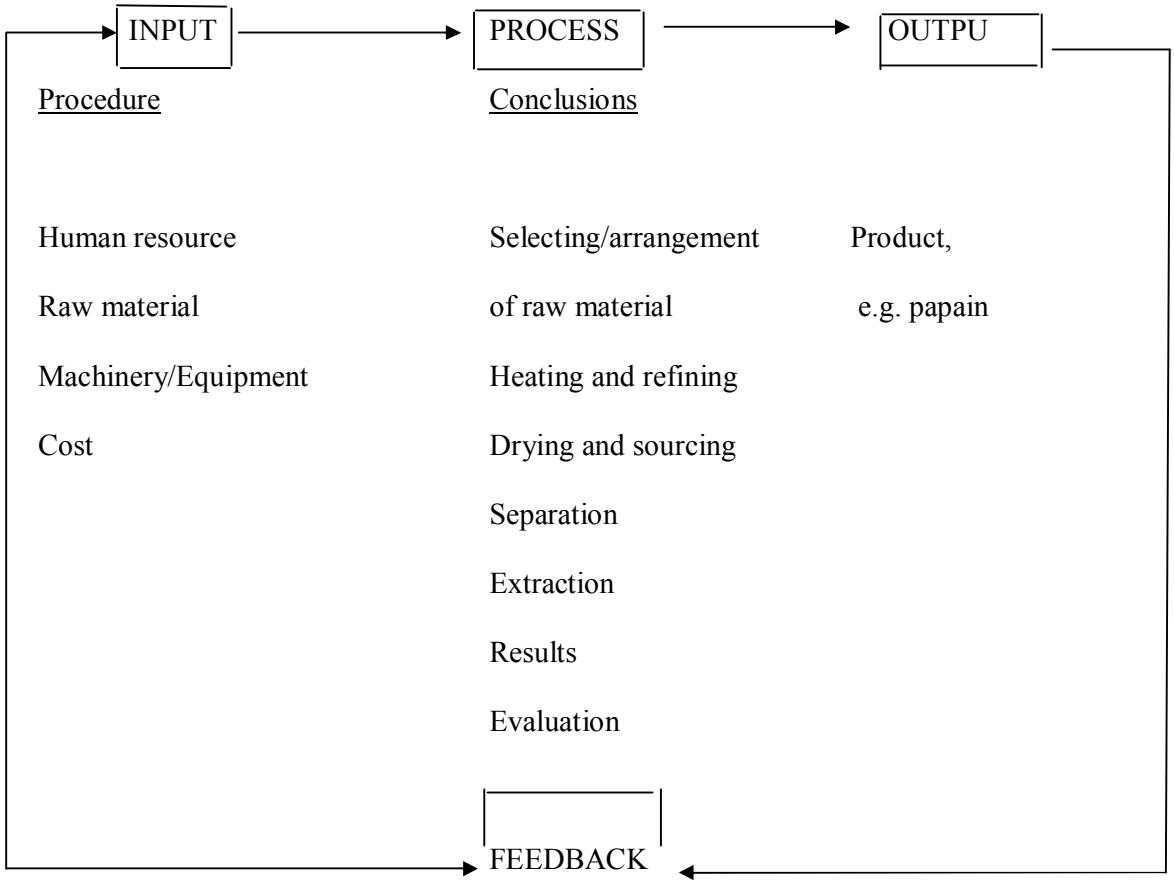
(iv) Symbolic outputs such as communication of policy intent

Feedback according to Easton is a communication process that produces action in response to information about the state of the political system or its environment, to structure within the system.

This theory suits this study because every policy serves as input in a system, and the outcome or performance serves as output. Therefore national policy on science and technology is a very viable policy that needs absolute commitment from government and individual in order to achieve meaningful success. For this to be achieved meaningful research has to be undertaken, adequate funding has to be given, right manpower should be recruited, maintained and developed and other facilities such as equipment and infrastructure are also necessary. All these inputs have to undergo certain processes such as the utilization of funds conducting experiments, purchases of raw materials, etc.

The figure below shows the functional elements of the organization as a system.

System Theory of NARICT




Source: Researcher, 2011

In the context of system theory, an organization is viewed as one element of a number of elements interacting interdependently. The flow of inputs from the environment to outputs is the basic starting point in describing the organization. The organization takes resources (input) from the outer system (environment) processed these resources and return them in chain form and there should be a feedback whether the product is satisfactory or not.

National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) are made up of many sub-systems which are interdependent and interrelated, and unless all the sub-systems function properly, the overall performance of the entire institution will normally fall below expectation. (For example see NARICT system theory. The input from the environment are the human resource, raw material, e.g. *papain*, machinery/equipment, finding etc. from the input it moves to the process stage and in here, there is procedure of processing the material for example selecting/arrangement of raw material, heating and refining of product then drying and sourcing separation, extraction and then the results and evaluation.

This stage is then completed and products moves to output. Here the work is concluded, product is ready to move to the environment or the industry. These products then move to the industry in the environment. It is then used and comments expected from the industry whether the product had met the standard, the reports goes to the organization as feedback. The R&D Section will work on it to see that the desired product or standard is achieved. This goes to the input section, and then to the output section from there to the environment until the environment or the industry using such product is satisfied. Therefore, any analysis of the National Research Institute for Chemical Technology and Institute for Agricultural Research's performance which focuses mainly on such departments as Finance and

Administration Department, Planning, Statistics and Information Technology departments without due reference to Research and Development Department will always produce misleading results because the research and development constitute the hub of any research system or institution. More so, (IAR) departments such as: Agronomy, Agricultural Extension and Rural Sociology, Plant Science, Soil Science and Agricultural Engineering have to inter-relate and operate as a system to ensure achievement of its set mandate.

For instance, no matter how finance and administration try to improve the overall financial performance of NARICT and IAR, while research and development department remain underdeveloped and underutilized, only very little can be achieved. In addition to all these, the system approach shows that no organization can function properly except all its parts or system carry out their assigned roles satisfactorily. The survival of an organization using the system approach will also be seen solely in terms of its ability to produce or export to its environment more outputs than the inputs it draws from the environment continually. While we must bear in mind that some institutions can be effective without been efficient, it is still very important for us to be able to assess correctly why an organization survives if its inputs are more than its outputs.

The above theoretical perspective is combined with the Rational Model as the theoretical framework for the study. The rational model of decision-making is a process for making logically sound decisions in policy making in the public sector, although the model is also widely used in private corporations. Herbert Simon, the father of rational model, describes rationality as "a style of behaviour that is appropriate to the achievement of given goals, within the limits imposed by given conditions and constraints". It is important to note the model makes a series of

assumptions in order for it to work, such as:

- The model must be applied in the system that is stable,
- The government is a rational and unitary actor and that its actions are perceived as rational choices,
- The policy problem is unambiguous,
- There are no limitations of time or cost.

Indeed, some of the assumptions identified above are also pin pointed out in a study written by the historian Drake as he states:

> In its purest form, the rational actor approaches presumes that such as a figure (as Constantine) has complete freedom of action to achieve goals that he or she has articulated through a careful process of rational analysis involving full and objective study of pertinent information and alternatives. At the same time, it presumes that this central actor is so fully in control of the apparatus of government that a decision once made is as good as implemented. There are no staffs on which to rely, no constituencies to placate, no generals or governors to cajole. By attributing all decision making to one central figure who is always fully in control and who acts only after carefully weighing all options, the rational actor method allows scholars to filter out extraneous details and focus attention on central issues.

Furthermore, as we have seen, in the context of policy rational models are intended to achieve maximum social gain. For this purpose, Simon indentifies an outline of a step by step of mode of analysis to achieve rational decisions. Ian Thomas describes Simon's steps as follows:

1. Intelligence gathering – data and potential problems and opportunities are identified, collected and analyzed.
2. Identifying problems.
3. Assessing the consequences of all options.
4. Relating consequences to values – with all decisions and policies there will be

a set of values which will be more relevant (for example, economic feasibility and environmental protection) and which can be expressed as a set of criteria, against which performance (or consequences) of each option can be judged.

5. Choosing the preferred option – given the full understanding of all the problems and opportunities, all the consequences and the criteria for judging options.

In similar lines, Wiktorowicz and Deber describe through their study on "Regulating biotechnology: a rational-political model of policy development" the rational approach to policy development. The main steps involved in making a rational decision for these authors are the following:

1. The comprehensive organization and analysis of the information
2. The potential consequences of each option
3. The probability that each potential outcome would materialize
4. The value (or utility) placed on each potential outcome.

The approach of Wiktorowicz and Deber is similar to Simon and they assert that the rational model tends to deal with 'the facts' (data, probabilities) in step 1 to 3, leaving the issue of assessing values to the final step. According Wiktorowicz and Deber values are introduced in the final step of the rational model, where the utility of each policy option is assessed.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.0 Introduction

This chapter is concerned with the research methodology used for eliciting data for the study. The chapter focuses on the nature of the data and the sampling techniques employed. It also focuses on the method of data presentation and analysis.

In this research, a survey research design was adopted. Nworgu (1991: pp58-59) said "descriptive survey aims at collecting data on, and describing in a systematic manner, the characteristics, features or facts about a given population." This research adopted the stratified random sampling technique, a none-probability sampling technique which categorized the samples into junior and senior staff.

## 3.1 Method of Data Collection

Two complementary methods were used for the collection of data for this study. These are the primary and secondary source of data analysis.

**(a) Primary Data:** These are first hand information or data which were derived through the administration of questionnaire, interview and systematic observation. The questionnaire is divided into four sections. Section A deals with the bio-data of the respondents, Section B focuses on the structure, organization and functions of NARICT and IAR, Section C touches on Science and Technology Policy implementation while Section D focuses on the level of autonomy given to both institutions.

**(b) Secondary Data:** The study also made an extensive use of secondary data. Data regarding the objectives of NARICT and IAR, government policy on science and technology, financial and material resources available to NARICT and IAR as well as the products of the institutions were derived from

secondary sources. Secondary data were collected through the examination of books, journals, papers, articles from individuals and research institutes, published and unpublished works, official documents of NARICT and IAR and their parent ministries. Documents were also sourced from government official documents, as well as international organizations. These documents were carefully examined and the information used to supplement the primary data collected.

## 3.2 Population for the Study

The population of this study comprised the staff of NARICT in Zaria, the staff of the Ministry of Science and Technology, Abuja, staff of IAR Samaru-Zaria and staff of the Federal Ministry of Agriculture and Rural Development with some key policy makers who are charged with the responsibility of overseeing the activities of NARICT and IAR. The entire population of the staff for NARICT was 367 and the Federal Ministry of Science and Technology, Abuja had 354 staff, the Institute for Agricultural Research has 822, while the Ministry of Agriculture and Rural Development had 547 making the entire population of the study 2090.

The total population of the staff of the National Research Institute of Chemical Technology (NARICT) was 367 comprising 203 junior staff and 164 senior staff, the Federal Ministry of Science and Technology had 252 senior staff and 102 junior staff, IAR had 253 senior staff and 569 junior staff. The Federal Ministry of Agriculture and Rural Development on the other hand had 547 with 345 senior staff and 202 junior staff. The junior level comprised staff on levels 1- 6 while the senior level comprised those staff on levels 7-17, including the management staff.

### 3.3 Sample Size and Sampling Techniques

In determining the sample size for this study, the method championed by Boll and Gall (1977) as quoted by Adamu (unpublished) in Adetoro (1986) was adopted. He recommended "a sample of 20% to be drawn from the population which does not exceed 1,000 and 10% up to 5,000 and 5% up to 10,000 populations", in terms of enough sample size to ensure representativeness. Also, according to Cochran (1963) "if the population exceeds 8000 the sample fraction is less than 5%". But, Ilersic (1964) stated that "to maximize degree of accuracy or precision in the sample results for any given outlay, the largest practicable sample size is used". 'Practicable' here; include affordability of the researcher among other variables.

Based on the above, in determining the sample size of this study, 10% of the total population (2090) was used i.e 209 as the sample size for the study. Both Random and stratified sampling techniques were used to select those that constituted the sample size. The formula as given by Araoye (2004) was used to determine the sample size for the study:

$$n = \frac{Z^2 PQ}{e^2}$$

n = the desired sample size

Z = the standard normal deviates, usually set as 1.96, which corresponds to the 95 percent confidence level

P = the proportion in the target population estimated to have a particular characteristic.

Q = 1.0 – P

e = degree of accuracy desired, usually set at 0.05 or occasionally at 0.02

Using the formula above, the selected sample size is approximately 209 given that the proportion of female entrepreneurships is 5% of the female population.

Thus, P = 0.20 - 0.22, Q = 0.95, Z = 1.96, e = 0.05.

The staff of NARICT and IAR and those of their respective parent ministries were stratified into both junior and senior staff and prospective respondents were randomly selected. The breakdown is presented in tabular form as follows:

**Table 3.1: Population and sample size of respondents.**

| | Population | | Status | Sample |
|---|---|---|---|---|
| NARICT | 367 | 203 | Junior | |
| | | 164 | Senior | 37 |
| FMST | 354 | 102 | Junior | |
| | | 252 | Senior | 35 |
| IAR | 822 | 569 | Junior | |
| | | 253 | Senior | 82 |
| FMARD | 547 | 202 | Junior | |
| | | 345 | Senior | 55 |
| TOTAL | 2090 | **1076** | Junior | **209** |
| | | **1014** | Senior | |

**Table 3.2. Staff Strength of NARICT as at 2008**

| Category | Staff Population | Percentage |
|---|---|---|
| Senior Staff | 164 | 45 |
| Junior Staff | 203 | 55 |
| **Total** | **367** | **100** |

*Source: Admin. Department NARICT, 2010*

**Table 3.3. Staff Strength of FMST AS AT 2008**

| Category | Staff Population | Percentage |
|---|---|---|
| Senior Staff | 252 | 71 |
| Junior Staff | 102 | 29 |
| **Total** | **354** | **100** |

*Source: (FMST) Abuja, 2010*

**Table 3.4. Staff strength of IAR Samaru-Zaria as at 2008**

| Category | Staff population | Percentage |
|---|---|---|
| Senior staff | 253 | 30.8 |
| Junior staff | 569 | 69.2 |
| **Total** | **822** | **100** |

*Source: IAR Samaru-Zaria 2010*

**Table 3.5 Staff strength of FMARD AS AT 2008**

| Category | Staff Population | Percentage |
|---|---|---|
| Senior staff | 345 | 63.07 |
| Junior staff | 202 | 36.93 |
| **Total** | **547** | **100** |

*Source: FMARD ABUJA, 2010*

**Table 3.6. Summary of total number of senior and junior staff**

| Category | Staff population | Percentage |
|---|---|---|
| Senior staff | 1014 | 48.5 |
| Junior staff | 1076 | 51.5 |
| **Total** | **2090** | **100** |

*Source: Summation of above tables*

It is important to note that the total population stated above include the top management of NARICT and IAR, Ministers, DG's and Directors, Permanent Secretaries, Directors in the Ministry of Science and Technology, and Directors in the Ministry of Agriculture and Rural Development which also constituted our sample size for the study.

### 3.4 Data Gathering Techniques

#### 3.4.1 Administration of Questionnaire

Questionnaires were designed and drawn in the areas relevant to the test of the hypothesis postulated. These questions were drawn to elicit information on government commitment to the implementation of the policy on science and technology as it relates to NARICT and IAR. The questionnaires also sought to appraise the Agricultural policy implementation and the level of autonomy given to

both NARICT and IAR. The questionnaires were administered to the staff of NARICT and IAR in Zaria, the staff of the Federal Ministry of Science and Technology and Ministry of Agriculture and Rural Development Headquarters, Abuja. Both the open ended and close ended questionnaires were designed. The open ended questionnaires were designed to allow the respondents to express their opinion on particular issues without restriction. This, the researcher believed would lead to getting some information which the researcher might not envisage or might not get through the close ended questionnaires. The closed ended questionnaires however, were designed to guide the respondents in answering questions that they might not really have appropriate answers to as envisaged by the researcher. A total of 209 questionnaires were drawn up based on the sample size selected and same were distributed to the respective respondents.

### 3.4.2 Interview

To compliment the data derived through the questionnaire administered, the researcher had a face to face interview with some top management officials of NARICT and IAR, the DG'S and some Directors of the Federal Ministry of Science and Technology, and the Ministry of Agriculture and Rural Development, Abuja, including some stakeholders from the public. Considering the status and, strategic offices and experience of the respondents interviewed, the researcher believed that their responses would yield or reveal much information that would enrich the study.

The interview also permitted clarification of some issues that were not clear to the interviewees in the areas of the activities of NARICT and IAR. This might not be possible in questionnaire administration. The interview was carried out by the researcher with the support of some field assistants. The researcher personally

conducted most of the interviews with the top officials for example ministers, permanent secretaries, and the D/G/CEO's of both research institutes involved.

### 3.4.3 Observation

The data collected for this research study were derived through this method were derived through observation of the respondents who are staff of the institutions studied. Care was also taken to avoid error by carefully observing events such as the way they carried out their official functions e.g. research work, administrative duties and their attitude to work. These were carefully documented them as they occurred. As an insider, the researcher had no problem in observing the physical facilities and material available in the parastatals. In addition, the products of the parastatals were physically observed and noted down on paper.

## 3.5 Sources of Secondary Data

The sources of secondary data for this study were books, journals, papers, articles from individuals and research institutes, published and unpublished works, official documents of NARICT and IAR and their parent ministries and other government official documents, as well as other documents of international organizations. These documents were carefully examined and the information used to supplement the primary data collected.

## 3.6 Method of Data Presentation and Analysis

Simple statistical tools were used to present and analyze the data collected for the study. Since the essence of this study is to examine the efficiency and effectiveness of the national policy on science, using NARICT and IAR as case study,

the researcher found it appropriate to make use of tables, frequency distributions and percentages in presenting data collected from the questionnaires administered to the target population. The Chi-square distributions method of analysis was used in testing the hypotheses formulated in chapter one. The technique was considered suitable because the scale of measurement of the data was nominal and the researcher was interested in investigating significant relationship between two independent populations. All hypotheses were tested for significance at 5% level of significance.

### 3.7 Limitation of Method

One of the limitations of the methodology was the nature of the population, the way in which the population of the study was placed made the sampling procedure to be problematic. The staff of the two parent ministries in Abuja was also reluctant in giving information as they did not see any relevance in studying a parastatal like the National Research Institute of Chemical Technology (NARICT) or Institute for Agricultural Research (IAR). The staffs of the two institutes were also reluctant in giving accurate information about the organization and its activities because of the fear that the government may decide to close down the parastatal if found not to be doing well. There was a problem in assessing secondary data such as books and internet materials. This problem was mitigated by getting current books, journals and conference papers etc all on the subject matter. In the case of the internet materials, there was a need to register with the author of the topic in the internet and also in case of power failure with the PHCN, alternative generator source was used.

# CHAPTER FOUR

# POLICY ON SCIENCE AND TECHNOLOGY/ THE OPERATIONAL PROFILE OF NARICT AND IAR

## 4.0 Introduction

This chapter discusses the administrative and operational profile of National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) The discussions include the objectives/operational structures of these research institutes and how these objectives have been achieved.

## 4.1 Operational Profile of NARICT and IAR

### 4.1.1 Historical Background of NARICT

Technological development has become a major policy thrust in most developing nations including Nigeria. The aim is to achieve a sustainable technological development through the domestication or indigenization of such technology. In order to achieve this objective, the Federal Government of Nigeria set up many agencies in such area of developing indigenous technology. One of such agencies is the National Research Institute for Chemical Technology (NARICT) to carry out research and development work (R & D) in the field of chemical and leather technology; the industrial philosophy behind such R&D activities is import substitution through the processing and utilization of indigenous raw materials for industrial development. (NARICT Annual Report, 1999)

The institute which is today known as National Research Institute for Chemical Technology began as hides and skin demonstration and training project established by the Food and Agricultural Organization (FAO) and United Nation Development Program (UNDP) in collaboration with the Federal Government of Nigeria and the then Northern Nigerian government in 1964.

In 1972, the FAO and UNDP handed over the project to the Federal Government and it was renamed Federal Leather Training Institute. In 1976, the institute was upgraded to a research institute named Leather Research Institute of Nigeria (LERIN) and placed under the supervision of the Agricultural Research Council of Nigeria (ARCN) and later the National Science and Technology Development Agency (NSTDA), Zaria.

According to (NARICT Annual Report, 1999), as a leather research institute, its mandate includes research and training in all aspects of leather, science and technology. The research activities cover hides and skins improvement, development of local tanning agents and mechanism of tarnage, leather auxiliaries, foot wear and leather goods development, quality control and standardization of leather and leather products, improvement process in slaughter houses and utilization of factory bye products, control and treatment tannery, effluents, economics and marketing research and extension services, library publication and documentation.

The technical training aspect of her mandate sought to train students at certificate and diploma levels in leather, foot wear and leather goods technology. Most of the research done during this period was aimed at improving the techniques of traditional tanners to enhance the quality of their leathers; developing leather auxiliaries for local raw materials for use in the domestic leather industries. By 1988, the institute's mandate was expanded to include chemical technology and its name was changed to National Research Institute for Chemical Technology (NARICT) to reflect its new mandate. (NARICT Annual Report, 2000)

### 4.1.2 Objectives of NARICT

The main objective of the national research institute for chemical technology,

Zaria is to develop the technologies required by the chemicals industry and undertake research and development work into:

1. a) Processes for the conversion of agricultural;
   b) The processing of commercial grade chemicals to laboratory grades
   c) The derivation of secondary chemicals from petrochemicals, cool chemicals, etc.,
   d) The production of functional polymers and engineering plastics, their characterization and utilization;
   e) The processing of hides and skins into leather products; and
   f) The processing of natural and man-made laboratory.
2. Establish and operate a chemicals testing laboratory
3. Establish and operate quality control laboratory for hides, skins, leather and leather producers.
4. Provide environmental monitoring and control services with respect to chemicals, leather, textiles and plastics.
5. Design, develop and produce chemical and leather industry machinery and equipment.
6. Transfer chemical and leather industry machinery production technologies to private sector industries and render consultancy and extension services to such and other industries.
7. Collaborate with higher institutions, government agencies, corporate bodies and international organizations in the execution of its programme and project.
8. Accept on its own terms, trainees for practical work attachment in its work and
9. Undertake any other activities in connection with all or any of its functions.

**Source: NARICT 2005 Annual Report. Pg. 9**

### 4.1.3 Organizational Structure of NARICT

According to NARICT investment profile booklet, NARICT, as a Grade–A parastatal, is headed by a Director-General/Chief Executive Officer who is responsible for the overall and day-to-day management of the Institute. The Institute presently has a Governing Board which is responsible for the general determination of policy. The institute's organizational structure is currently based on two technical departments and one non-technical department, each headed by a Director. The technical departments are: (i) Research and Development; and (ii) Planning, Statistics and Information Technology. The non-technical department is the Administrative and finance Department. Each Department consists of divisions and units. The Director-General/ Chief Executive officer undertakes the daily management of the institute through the committee of Directors (COD), the Heads of Departments/Divisions/Units, and the various standing committees. The institute also operates a SERVICOM Unit that ensures service compact to all NARICT clients and other Nigerians. The SERVICOM UNIT is headed by a Deputy Director. (NARICT Annual Report, 2000)

### 4.1.4 Divisions and Units under Research and Development Department and their Activities.

Research and Development department comprises the following divisions and units:

(i) Industrial Chemical and Biochemical Division

(ii) Petrochemicals and Polymers Division

(iii) Leather and Environmental Services Division

(iv) Fabrication Engineering Division

(v) Instrumentations Units

(vi) Laboratory Services Unit

(vii) Pilot Plans Unit (NARICT Annual Report, 1999)

**a. Industrial Chemicals and Biochemical's Division:**

This Division consists of:

(a) Industrial Chemicals unit

(b) Biochemical unit

(c) Research and Development work in the conversion of solid minerals into intermediate and finished products for use in manufacturing industries.

(d) R&D work designed for the production of essential industrial chemicals from locally available materials such as plants, animal by-products and agricultural wastes.

(e) R&D on the local production of chemicals and reagents for secondary schools and organizes periodic training workshops for science teachers in the nation's secondary schools.

**b. The Industrial Chemical Unit.**

There are two aspects to this unit, the organic and inorganic unit handles mainly non-metallic mineral raw materials with a view of producing intermediate chemical products that find application in various chemical and allied industries such as: Ceramic, glass, paint, metallurgy, cement, paper, plastic trays, soap and detergents to mention but a few.

The industrial organic chemical unit handles research works on locally available oils with a view to converting them into downstream agro-chemicals such as soap, fatty acids, fatty alcohols and glycerin. The chemical finds importance

in plant, lubricant soap, pharmaceutical, cosmetic, perfumery and explosive industries. The unit also engages in synthesis or other organic chemicals such as benzoic acid for the food industries and the production of dyes and the production of common organic solvents such as ethanol. (NARICT Annual Report, 1999)

Specified projects in this unit include:

(i) Processing and utilization of solid minerals

(ii) Production of laboratory chemicals and reagents for secondary and tertiary institutions

(iii) Production of oil from oil seeds

(iv) Extraction of essential oil from oil plants.

**c. The Biochemical Unit**:

Under the biochemical unit, the research work is geared towards the production of industrial biochemical from natural sources.

(i) production of industrial enzymes (e.g. papain)

(ii) production of carbohydrate based biochemical (e.g. corn starch)

(iii) production of botanical pesticide from neem plants

(iv) production of bovine serum albunin and

(v) production of essential oil from plants

**d. Petrochemical and Polymers Division**

This division engages in.

(a) The development of cost – effective technologies for the conversion processes of petrochemicals into intermediate and semi-finished products.

(b) The development of technologies for the production of functional

Polymers and engineering plastics from locally available raw materials.

(c) Extraction of colorants and other chemicals from local floral and fauna

Their work also includes the production of useful organic products like resins, dyestuffs and furfures from readily available local sources.

The specific projects under this division are,

(i) production of dyestuffs and pigments

(ii) production of deodorized kerosene

(iii) production of synthetic resinal (urea formaldehyde and butylated urea, alkydresins, putifuctional alcohols and polyesters)

(iv) production of furfures from agricultural wastes.

(v) Production of natural rubber later concentrates from field rubber latex.

**e. Leather and Environmental Service Division.**

This unit was established to undertake research and development projects and services on leather and leather products and to monitor the development of treatment processes of chemical pollutants.

The targeted beneficiaries of such research and development work and services include the Nigeria tanning industries, Nigeria leather products industries, Nigeria entrepreneur and government agencies. Specific projects in this unit include:

(i) The processing of natural and man-made fibres into useful products

(ii) Using biotechnology to develop new products for the tanning industries.

(iii) Investigating the tanning potentials of Nigeria Plant and minerals

(iv) Formulation and introduction of Parkia and Combination (Prakia aluminum) tannage in Nigeria tanneries.

(v) Preparation of Nigerian standard specifications for upper leather, wet blue and pickled skins

(vi) Improving the quantity and quality of rural tanning industries.

(vii) Assessment of leather quality of Nigeria sheep and goat skins infested by common dermatomes.

(viii) Environmental monitoring and control services in the leather, textiles, chemicals and plastics industries.

(ix) Training and consultancy services in the areas of hides and skins production, improvement and utilization.

(x) Training and consultancy services in the field of leather and leather products manufacturing standards (in conjunction with the stands organization of Nigeria) for leather and leather products.

(xi) Analysis of water and waste water.

(xii) Monitoring the various industrial discharges around the environment.

(xiii) Designing of effluent treatment plant

(xiv) Monitoring the performance of installed water treatment plant.

(xv) Carrying out environmental impact assessment studies for organization.

(xvi) Manpower training for industries and relevant organizations in the area of environmental control.

This control has been accredited by the Federal Environmental and Protection Agency (FEPA) for the purpose of reading consultancy services in the area of efficient treatment and general environmental pollution control (NARICT Annual Report, 2001)

**f. Fabrication Engineering Division.**

The aim of this unit is to design, produce and install chemical processing plants for the purpose of scaling up to Pilot Scale level for completed research projects in the area of the mandate. As such services are provided in the area of consultancy services in design, fabrication and installation of processing equipment and machine parts.

The Division undertakes the following.

(i) Fabrication of machines, prototypes and spare parts of machinery

(ii) Transfer of machinery fabrication technologies to entrepreneurs

(iii) Repairs and adoption of machines and plants

**g. Laboratory Service Unit:**

This unit carries out the following functions:

(i) Coordinates the compilation and purchase of laboratory requirement of the institute.

(ii) Maintain all the inventory of laboratory materials such as equipment, chemicals, glass wares etc and submit regular reports on their conditions and stock levels.

(iii) Authorities release and coordinate the use of laboratory equipment, glass wares and chemicals.

(iv) Ensures the safety of the institute's laboratories

(v) Coordinates the jobs of the various laboratory technologists

(vi) Consultancy and training in the area of laboratory services.

**h. Instrumentation Unit**

This unit undertakes:

(i) Analyses of chemical samples from within the institute and outside.

(ii) Routine maintenance and repairs of laboratory equipment.

(iii) Consultancy services and training in the area of analytical equipment operations and maintenance.

**i. Pilot Plant**

This unit is to gather and analyse technology, economic data needed for the final process and plant designs and to determine the technology and economic viability of industrial chemical production. Consultancy services are provided on plant management, industrial scale up and manpower planning.

The Specific activities of the unit involves:

(a) Design and development of pilot plants for the production of chemicals, chemicals products, leather and leather products.

(b) Design and development of engineering processes required in the mandate areas of the Institute.

(c) Upgrading of successful research projects to pilot plants stage preparatory to commercialization of such projects.

(d) Development of skills in equipment design for pilot plants operations.

### 4.1.5 Planning Statistic and Information Technology Dept.

This department comprises the following Divisions:

(i) Planning and Statistics

(ii) Production

(iii) Marketing

(iv) Library and Information Services

(v) Data Unit

These departments carry out various activities through their program, the result of the research and development activities are extended to end users, through workshops, practical demonstration, publication and provision of technical assistance, while consultancy services are equally rendered to clients on the institute's activities. Furthermore, the program covers the collection, processing, analysis and publication of vital statistics on the leather and chemical industries in Nigeria. (NARICT Annual Report, 2000)

**a. Planning and Statistics Unit.**

The overall activities of this division are:

(i) Coordinating the formulation of capital programmes / projects of the institute.

(ii) Regular collection, collation and analysis of statistical data on hides, skins, leather, leather products, chemicals and chemical products.

(iii) Regular collection, collation and analysis of techno-economic data of general interest, especially for the enhancement of management decision in the institute.

(iv) Coordinating, monitoring and evaluating the implementation of all planned programmes / projects of the institute, particularly as outlined in the institute's approved capital budget.

(v) Coordinating the preparation of the Institute's capital budget and rolling plans.

(vi) Preparation and production of the Institute's weekly quarterly, annual report, and other reports.

(vii) Maintenance of a data bank on the above outlined activities.

**b. Production Division**

The production division focuses on the production of leather and leather works. These include:

(a) Wet blue leathers

(b) Crust leathers

(c) Finished leathers

(d) Adire and Ovada leathers

According to NARICT Annual Report, (2001) assorted types of footwear such as Gents shoes, ladies shoes, children shoes, sandals, slippers, military combat boots and military officers set look shoes are also produce here. Other leather goods produced by this institute includes, conference bags and folders, suitcases, pouffes, traveling bags, belts, wallets, hand patches, seat covers, upholstery covers, military field seats, camp beds and FIFA grade footballs.

**c. Marketing Division**

This division undertakes the following:

(a) Coordinating the promotion of NARICT activities through publicity.

(b) Coordinating the investment promotion of NARICT products and projects through the organization of and participation in investment for trade fairs, exhibitions and similar activities.

(c) Coordinating industrial and general consultancy services such as pre-feasibility and feasibility studies, investment counseling and technical linkages.

(d) Adopting marketing strategies for the sales of NARICT products such as leather, leather products, chemicals and chemicals products.

(e) Preparation of brochures, handbills, briefs, and booklets that promote and publicise the activities of the institution.

**d. Library and Information Services.**

The functions of this division include:

(i) Acquisition, collection and maintenance of books, scientific journals, serials, reports, CD-ROM bittes, other publications.

(ii) Arranging and maintenance of inter-library cooperation through: exchange of publications and inter-library loans and library digital information.

(iii) Documentation services

(iv) Computer Training

(v) Promotion of effective dissemination of scientific and technical information in the area of the institute's mandate.

(vi) Promotion of education and reference materials (books, monographs films) and photocopying services.

(vii) Computer and Desktop publishing services

(viii) Promotion of computerized data bank on the institute's research and development activities.

**e. Data Unit**

This unit engages in:

(i) Developing and maintenance of data bank on the institute's activities.

(ii) Provision and maintenance of interact and related activities

(iii) Acquisition and maintenance of computers, computers accessories and software.

(iv) Preparation and packaging of some of the institute vital documents.

### 4.1.6 ACTIVITIES/STRATEGIES OF NARICT

**a) Neem–Based Biopesticide**

The National Research Institute for Chemical Technology, Zaria, has developed sustainable and adaptable technologies for the processing of neem seeds into oil. NARICT neem – based bio-pesticide plant is an agro-allied plant, which processes neem seeds into neem based pesticide, fertilizer, neem oil and other secondary products that can be derived from the neem seed. NARICT has also designed and fabricated a power screw press as a highly efficient extractor that retains the potency of active ingredients. The final product (neem-based pesticide contains 1500ppm *azadirachtin* (0.15% E.C.). (NARICT Annual Report, 2005)

i) **Demand Analysis:** Generally, the pesticide market is highly lucrative, especially when there is no alternative measure to crop protection. According to the 2004 edition of the Micro Encarta Encyclopedia, annual global crop destruction and post harvest loss due to the activities of pests is estimated at 40-50%. Pesticides worth about $35 billion were used worldwide in 2006 as a result of increased farming activities which also grows along with increase in population and the introduction of more efficient farming methods.

Neem-based biocides have a great advantage over the conventional ones and would command a sizeable share of the world market because they are non-toxic, biodegradable and generally mild on the environment and less prone to the problem of pest resistance than the synthetic ones. Global concern over pesticides that destroy

useful insects like bees makes the neem idea even more attractive because findings show that Neem does not destroy useful insects like bees. (NARICT Annual Report, 2005)

Entrepreneurs can take advantage of this emerging market as neem belts already exist in abundance in the frontline states of the country (Borno, Katsina, Kebbi and Zamfara) and it thrives well in all of Nigeria's ecological zones. Neem seeds from Nigeria contain the highest concentration of neem-bioactive ingredients (containing about 0.6% azadirachtin content while Indian neem and that of other Asian countries is 0.2, 0.3%). Its export potentials are very high, especially in countries like India, Germany and USA.

**ii) Industrial Uses:** Every part of the neem tree is useful. The following products can be derived from it. It is useful in the manufacture of soap and therefore haSs export potential.

**b) Insecticides:** As an insecticide, it has both antifeedant and repellent effects on different insect species.

**c) Azadirachtin Technical Powder:** Meen technical powder grade, a primary product of need processing developed under critical R & D works, is an industrial raw material that is in high demand in the international market for the production of pesticides.

**d) Urea Coating Agent:** When applied as urea-coating agent in fertilizer production, it enhances urea utilization and reduces the quantity of urea needed.

**e) Neem Cake:** This serves as a source of NPK in fertilizer production while also controlling root nematodes and enhancing urea efficiency. It is also useful as feed for animals. On-going research into the debitterisation of the production would make it a highly nutritional complement to animal feed products currently sold in the

market.

**f) Cosmetics and Healthcare:** Neem lead, bark, oil are widely used in the manufacture of ointments, face clearing agents, toothpastes, etc.

**g) Production Process:** Production technology can be obtained at NARICT.

**h) Raw Materials:** The neem seed is the basic raw material required. Other inputs for the bio-pesticides plants are solvent, stabilizers and emulsifiers. Sources of Raw Materials: The raw materials are abundantly available in Nigeria.

**i) Synthetic/Natural Rubber Handgrips for motorcycles, bicycles and wheel barrows**

Over the years the demand for handgrips has increased considerably in the "cycle" industry. Motor cycles and bicycles utilize large quantities of handgrips which help to keep a firm hold on the handles of motorcycles, bicycles and wheel barrows. Handgrips are made from different materials. The nature and the type of application dictate the type of materials used. In recent time, elastomers have gained popularity in the manufacture of handgrips, because they are cheap, have low thermal conductivity and can be compounded to withstand different environmental conditions. (NARICT Annual Report, 2006)

i Raw Materials**:** These include synthetic and natural rubber, accelerators, fillers, processing oils and vulcanizing agents.

ii Process Technology**:** The process technology is available in NARICT

iii Machinery and Equipment: NARICT also produce local machines and equipment.

**f). Simple Distillation Unit (Designed By NARICT)**

According to the NARICT Annual Report, 2006) a simple distillation unit is unique, handy and very easy to install and operate. It can be operated with kerosene stove in places where there are no electricity and gas. Well water or stream water could be used where there is no tap water.

**g) School Laboratory Chemicals & Reagents.**

Everyone talks about the deplorable state of the nation's secondary school science laboratories. One of the problems in carrying out chemistry practical studies in Nigerian secondary schools is lack of good quality chemicals and reagents. In 1997, the National Research Institute for Chemical Technology (NARICT) and Raw Materials Research and Development Council (RMRDC) were mandated by the National Council on Science and Technology (NCST) to develop a programme for the local production of high quality laboratory chemicals and reagents.

**Table 4.1 below shows the list of chemical whose local technologies of production, NARICT has developed.**

**A.ACIDS**

| S/NO/ | NAME | RAW MATERAIALS | USE |
|---|---|---|---|
| 1. | Sulphuric Acid | Sulphur | General analysis |
| 2. | Hydrochloric acid | Hydrogen chloride<br>(Electrolysis of brine | General analysis |
| 3. | Nitric acid | Ammonia | General analysis |
| 4. | Acetic acid | Ethanol | General analysis |

**B. BASES**

| | | | |
|---|---|---|---|
| 1. | Sodium hydroxide | Brine (Electrolysis of brine | Quantitative analysis |
| 2. | Ammonia Solution | Natural gas | Quantitative Analysis |
| 3. | Barium chloride | Natural gas | Quantitative Analysis |
| 4. | Sliver nitrate | - | Quantitative Analysis |
| 5. | Calcium hydroxide (lime water | Calcium chloride (Lime water | Quantitative Analysis |

**C. GENERAL CHEMCIALS**

| | | | |
|---|---|---|---|
| 1. | Potassium Permanganate | - | Quantitative Analysis |
| 2. | Potassium dichromate | - | Quantitative Analysis |
| 3. | Iodine crystal | Iodine | Quantitative Analysis |
| 4. | Sodium Potassium tartrate | - | Quantitative Analysis |
| 5. | Copper Sulphate | - | Quantitative Analysis |

## D. GENERAL CHEMCIALS CONTINUED

| | | | |
|---|---|---|---|
| 6 | Potassium nitrate | Potassium Chloride & Sodium Chloride | Quantitative analysis titration |
| 7. | Sodium Carbonate | Ammonia gas & Sodium Chloride | Quantitative Analysis |
| 8. | Calcium carbonate | Limestone | Quantitative analysis –titration |
| 9. | Sodium Chloride | Rock salt | Quantitative analysis –titration |
| 10. | Potassium nitrate | | Quantitative analysisi –titration |
| 11. | Sodium thiosulphate | | Quantitative analysis –titration |
| 12. | Oxalic acid | | Quantitative analysis –titration |
| 13. | Ferrous ammonia sulphate | | Quantitative analysis – titration |
| 14. | Potassium iodide | | Quantitative analysis titration |
| 15. | Potassium iodide | | Quantitative analysis titration |
| 16. | Ferrous sulphate | | Quantitative analysis –titration |

| | | | |
|---|---|---|---|
| 17. | Sulphur | | Quantitative analysis – titration |
| 18. | Iron filing | | Quantitative analysis –titration |
| 19. | Ferrous sulphate | | |
| 20. | Ferric chloride | | |
| 21. | Sodium sulphate | | |

**E. ORGNIC CHEMICALS**

| | | | |
|---|---|---|---|
| 1. | Methylate Spirit | Ethanol | Solvent |
| 2. | Absolute alcohol | Molasses/sugar | Solvent |
| 3. | Formaldehyde | - | Preservative |
| 4. | Chloroform | - | Solvent |
| 5. | Acetone | - | Solvent |
| 6. | Benzene | Petroleum | Solvent |
| 7. | Carbon tetrachloride | Methane & Chloride | Solvent |

**F. INDICATORS**

| | | | |
|---|---|---|---|
| 1. | Phenolphthalein | - | Quantitative analysis –titration |
| 2. | Methyl red | - | Quantitative analysis – titration |
| 3. | Methyl orange | - | Quantitative analysis – titration |
| 4. | Starch solution | Cassava, maize and potato | Quantitative analysis-titration |

**Source: NARICT, Zaria 2006 Annual Report**

**h). Raw Materials and Chemicals**

Raw materials for the production of some chemicals are locally available. Most of the inputs for the production of reagents can be sourced locally. Distillation unit can be fabricated by NARICT at moderate fee.

**i) Process Technology**

This is obtained through training organized by NARICT at moderate fees.

**j). Collaboration with other Organizations:** NATRICT has over the years established linkages with both industry and public sector agencies. This has been achieved through direct collaboration in research and development projects, extension services, consultancy, short-term training, training workshops, seminars, trade fairs, investment fora and marketing. Notable among these collaborations and linkages are those with:

(a) Entrepreneurs in the pharmaceutical, plastics, ceramics, paints, food, chemicals and chemical products, petrochemicals and related industries; agriculture and agro-related business; leather and leather products industries and so on.

(b) Public agencies and institutions with whom NARICT collaborates include the Raw Materials Research and Development Council (RMRDC), National Office for Technology Acquisition and Promotion (NOTAP), the Standards Organization of Nigeria (SON), the Industrial Training Fund (ITF), the National Directorate of Employment (NDE), the National Poverty Eradication Programme, Energy Commission of Nigeria, the various federal ministries, particularly those of Agriculture, Commerce and Industry and Environment; various universities, Polytechnics, Colleges of Education, secondary schools and colleges.

NARICT also collaborates with international organizations such as the United Nations Industrial Development Organization UNIDO), the United Nations Development Programme (UNDP). Central Leather Research Institute (CLRI), India, the Institute for Leather Research, TNO in the Netherlands, and Commonwealth Science Council in London. (NARICT Annual Report, 2007/2008)

### 4.1.7 GOVERNMENT SUPPORT OF NARICT

#### i. Funding of NARICT

Although the institute generates little income, the major source of funding the activities at the institute is from the annual Federal Government subvention. The institute also generates funds from consultancy services, training of entrepreneurs and sales of patents hand product. However, the researcher as part of this study would assess or examine the adequacy of these sources of fund.

#### ii. The Relationship Between the Institute and Government

The institute is a parastatal thereby making relationship between it and the responsible ministry well defined. The supervisory ministry is the Ministry of Science and Technology with the minister, as the overall head. He directs the activities of the institute on behalf of the federal government

#### iii. Ministerial Control.

The ministry has legal, political and financial control on the National Research Institute for Chemical Technology, Zaria.

#### iv. Legal Control

According to the NARICT Annual Report, 2007/2008) The act establishing the institute is the most important instrument of control. It specifies the objectives and functions of the institute, in addition to endowing it with general and specific powers and prescribing its formal relationship with government authorities, it also specifies

government responsibilities in the provision of services. This makes the institute to be limited by the provisions of the act. Hence it can not do anything outside the provision of the law irrespective of the importance of such needs to the institute. It can therefore be asserted that NARICT act controls every aspect of the institute's activities.

**v. Political Control**

Being the owner of the institute, the federal government exercises full political control over NARICT. Government determines who heads the board of governors and appoints the chairman while the Minister of Science and Technology appoint the members of the board. Government has taken over the appointment of the Director General/Chief executive officer of the institute from the minister who had been doing so before. The minister appoints the advisory council, regulates their activities and gives them directives. In essence, all regulations made for the Institute must be approved by the Minister before being effective. This is in addition to the recruitment of Senior Staff from CONTISS 7 and above as well as the conditions of service of staff of the institute. It is unfortunate that the condition of service as laid down by government for the institute is responsible for the difficulty being encountered by the institute in obtaining and retaining highly skilled staff, it also hinders the level of motivation and renders the staff inefficient and less effective when compared to their counterparts in some developed countries such as USA, Britain, Japan and German.

The whole Minister-Board relationship is enshrined in numerous statutory provisions for ministerial control; an example of this is the act establishing the institute which state thus:

> The minister may give to the board directions of general nature or relating generally to particular matters and in any event ----- the board should comply with any such direction given by the minister.

Also, the Minister has to approve the Board's decisions before they can be

implemented. The consequence of this ministerial control according to Teriba. (1978) is that it"sometimes kills corporate initiative" resulting to unnecessary delays in implementing decision. This situation would have been avoided if the institute had more autonomy that gives the Board of governors the power to formulate and implement policies without recourse to the minister of science and technology.

**vi. Financial Control.**

Survival and efficiency of any organization either public or private depends on the proper management of its services. This accounts for why government insists on proper financial management by NARICT. The institution is subjected to the budgetary procedures of the treasury as is the case with the ministries. Government however applies certain control measures in order to guarantee accountability. Part of the check and balances mechanism part in place is that the act establishing the institute, while making financial provisions for its operation, also requires that the institute sends its annual estimates to the Minister of Science and Technology for his perusal and adjustment where necessary before its inclusion in the ministry's budget. Since the institute is funded by the government, it has to ensure that its budget is within the limit of the provision for it, hence the control of the institute is also attested by the financial provision by the science and technology ministry or government as the case may be.

Annual submission of dully audited statement of account to the minister is also a requirement of the institute. These audited accounts have to be approved by the minister. The effect of this is that, this exercise constitutes a major problem faced by the institute as a result of delays in the approval of the institute's expenditure and the subsequent release of funds.

**Table 4.2: Shows Federal Government budget allocation NARICT, 1998 – 2008**

| Year | Capital | | | | | PERSONNEL COSTS | | OVERHEAD COSTS | |
|---|---|---|---|---|---|---|---|---|---|
| | AMOUNT REQUESTED ₦ | amount approved | amount received | amount approval as % of amount requested | amount received as % of amount requested | amount approved | amount received | amount approved | amount received |
| 1998 | 500,000,000 | 54,600,000 | 54,600,000 | 10.92% | 10.92 | 28,684,380 | 28,684,380 | 13,676,148 | 13,676,148 |
| 1999 | 550,000,000 | 17,500,450 | 17,500,450 | 3.18% | 3.18 | 50,597,680 | 50,597,680 | 13,276,140 | 13,276,140 |
| 2000 | 585,000.000 | 9,717,450 | 9,717,450 | 1.66% | 1.66 | 52,197,669 | 52,197,669 | | |
| 2001 | 605,000,000 | 25,534,665 | 25,534,665 | 4.22% | 4.22 | 110,644,268 | 110,644,268 | 14,034,384 | 14,034,384 |
| 2002 | 750,000,000 | 124,000,000 | - | 16.53 | 16.53 | 140,360,628 | 140,360,628 | 5,233,071 | 5,233,071 |
| 2003 | - | - | - | - | - | 140,360,628 | 140,360,628 | 6,736,320 | 6,736,320 |
| 2004 | 780,000,000 | 30,000,000 | 30,000,000 | 3.85 | 3.85 | 138,796,906 | 138,796,906 | 21,639,320 | 17,311,258 |
| 2005 | 890,000,000 | 110,000,000 | 86,240,00 | 12.36 | 9.69 | 181,480,307 | 181,480,307 | 36,131,258 | 26,701,269 |
| 2006 | 909,000,000 | 752,000,000 | 507,000,000 | 82.73 | 55.78 | 280,491,024 | 280,491,024 | 84,000,000 | 84,000,000 |
| 2007 | 950,000,000 | 792,846,000 | 792,846,000 | 83.46 | 83.46 | 282,316,668 | 282,316,668 | 116,866,340 | 116,866,340 |
| 2008 | 1000,650,000 | 391,602,363 | 391,602,363 | 39.13 | 39.13 | 301,164,175 | 301,164,175 | 202,866,340 | 162,149,755 |
| Total | 7,519,650,000 | 2,307800,928 | 1,915,040,928 | 25.80 | 22.84 | 1,707,094,333 | 1,707,094,333 | 514,459,321 | 459,9**84,685** |

**Source: NARICT Annual Report**, 2007/2008)

An assessment of Table 4.2 above shows that the approved budget for NARICT had always fallen short of the amount requested throughout the period under review. For example in the year 1998 the amount approved was 10.92% of the amount requested. Although, there was a marked improvement in 2006 and 2007 in which amount requested was 82.73% and 83.46% respectively, thereafter it dropped again, for example it was 39.13% with this scenario it is obvious that given that needs for which the institute based their request it could not execute most of the capital programmes planned, thereby limiting performance.

The trend is almost the same for the amount received as a percentage of amount requested. Also, it was observed that for the period under review, the amount approved in relation to amount received in relation to amount requested was 22.8%.

**vii. Challenges faced during the period**

Assorted leathers are used in the production of varied leather products, making the

industry a very important segment of the productive sector of the economy.

NARICT is an active participant in Nigeria's leather industry, both as trainers as well as primary and secondary producers. Our finished leather and leather products can compete in the international market.

**viii. Demand Analysis:**

Domestic production of finished leather and leather products is currently very low occasioning a very high supply gap. For example, it is estimated that Nigeria imports about 20 million pairs of shoes of all types annually while domestic production is estimated at not more than 4 million pairs per annum.

This means that out of the estimated total national demand of 24 million pairs, there is a supply gap of 20 million pairs. The situation is not too different in the case of finished leather and other leather products.

**ix. Raw Materials**

The raw materials required for the production of finished leathers are hides, skins and tanning chemicals, while those for leather products are finished leathers, lining, sole, insole, fitting, ornaments. Hides and skins can be obtained from abattoirs and slaughter slabs all over Nigeria. They are abundantly available in the northern part of Nigeria. Because of the abundance of raw materials, the bulk of the tannings in Nigeria are located in the north, but only few are working.

**x. Lack of finance**

As shown in Table 4.2 it has been seen from the analysis that lack of finance was one of the problems that militated against the effective performance of NARICT. Apart from inadequate finance, there was delay in the release of funds and there was no funding at all in 2002 and 2003.

**Table 4.2.1: Inadequate funding has also hamper proper training of the staff in the institute**

| Year | Research Staff trained | No of Research Staff Trained as % of Staff Population | Non-Research Staff trained | No of Non-Staff Trained as % of Staff Population | Staff Population | Research staff population |
|---|---|---|---|---|---|---|
| 1998 | - | - | - | - | 202 | 25 |
| 1999 | 15 | 7.14 | 16 | 7.62 | 210 | 25 |
| 2000 | 12 | 5.6 | 12 | 5.6 | 215 | 26 |
| 2001 | 9 | 4.1 | 5 | 2.37 | 220 | 26 |
| 2002 | - | - | - | - | - | 25 |
| 2003 | - | - | - | - | - | 22 |
| 2004 | - | - | - | - | - | 22 |
| 2005 | 7 | 3.31 | 7 | 3.3 | 211 | 22 |
| 2006 | 5 | 2.44 | 10 | 4.9 | 205 | 23 |
| 2007/2008 | 4 | 1.08 | 5 | 1.4 | 367 | 45 |

Source: NARICT Annual Report, 2007/2008)

Analysis of Table 4.2.1 indicates that the number of research staff trained had consistently declined from 1998 to 2008, both in absolute and relative terms. This is as a result of inadequate funding which invariably led to lack of qualified staff, thereby leading to poor performance.

However, it is imperative to note that the non provision of training opportunities for staff can lead to poor performance and low productivity. More is expected from trained staff than untrained staff due to the training which they have undergone.

In order to accelerate the performance of research institutes, there is need for all such institutes to carry out the functions of both research and training. Training is very important in that apart from assisting the employee in the most efficient performance of the job, it also boosts employee morale. Training of staff ensures that standard methods are used by trainees which mean that less supervision is required by properly trained staff.

Though the management may be sponsoring some staff for training and development, these opportunities did not extend to all the staff. This suggests that all is not well with the manner at which staff are selected for training at NARICT. This is a clear indication that selection for training at NARICT, is done haphazardly. However, it was discovered in the course of this study that not all the members of staff are aware that the institute has defined criteria for training. If they were all aware of this fact, this would have reflected in their reaction.

In the same vein, the institute has staff regulation, the information in this document include condition of service, entitlements of staff, and training. Training enhances staff performance as they undergo refreshers training like courses and workshops. Though NARICT sponsors staff for courses and workshops, these courses and workshop do not involve all staff within the organization. (NARICT Annual Report, 2007.2008)

**ACHIEVEMENTS OF THE OBJECTIVES OF NARICT**

The National Research Institute for Chemical Technology, Zaria was established to develop the technologies required by the Chemicals industry:

**Objective 1:** Its first major objective is to undertake research and development work into:

**a.** processess for the conversion of agricultural, minerals and other raw materials into chemicals.

Under the above objective NARICT has been able to produce fertilizer for agricultural products which are already in circulation in some of the states of Nigeria. NARICT has also been able to develop two types of fertilizer, one for root crops and the other for cereals which users have found very useful in enhancing their yields.

**b.** NARICT in is partnership with the Raw Materials Research and Development Council (RMRDC) Abuja is also producing essential oil from leaves.

Essential oils are odoriferous constituents of plant which are obtained in fruits, flowers, leaves, seeds, stems, bark, wood, as well as the whole plants. Essential oils

from three types of plant namely Lemon grass, Eucalyptus citriodora and eucalyptus camadulensis are being extracted using the essential oil plant fabrication in the institute.

These oils, especially Eucalyptus citriodora are being extracted and packaged. The oils are used in the pharmaceutical, cosmetics and perfumeries industries.

NARICT has been able to supply some individuals with this oil and calling for members of the public, individuals and cooperate groups to establish essential oil plant at cottage, small and medium scale industries levels. This will contribute to the country's economic development through import substitution, employment generation, and poverty alleviation and export of oils which meet international standard.

**Objective 2**, NARICT was established to provide environmental monitoring and central services with respect to chemical, leather, textiles and plastic.

Under the above, NARICT has been able to develop simple and suitable treatment techniques that will be acceptable to various industries. Analysis of effluents has been carried out for the tanneries in Kano and the textile companies in Kano and Kaduna. Also effluent treatment plants have been designed for tanneries and textile mills in Kano.

**Objective 3:** NARICT has been able to design, develop and produce machinery and equipment for the chemical and leather industries.

A programme called **programme 4,** known as Research and Development of Process Engineering and Pilot Plant was set up to develop chemical process and design of pilot plants for the production of chemicals.

NARICT was able to recondition and adopt an existing plant to produce fatliquors on a pilot scale and the fatliquors presently being imported are used extensively in leather processing by the Nigerian leather industry.

NARICT has been able to process locally available solid minerals; especially limestone for the production of lime, hydrated lime and precipitated calcium carbonate. These products are used in large quantities by leather, paints and pharmaceutical industries, as well as for water purification.

NARICT has also designed and constructed a lime kiln $CaCo_3$ feed stock with a capacity of ½ tones. The kiln performs excellently even at temperatures as high as

1300c.

In 1998 a bigger kiln of 3 tones CaCo3 capacity was built. This met the demands of the institute's tanneries and some cottage tanneries which presently find it difficult to import. The NARICT hydrated lime has been tested and found to be of very high quality.

Furthermore, the design of the cottage kiln and the technology of hydrated lime production are now available for entrepreneurs to take up and invest in the local production of hydrated lime and thereby reduce importation, conserve foreign exchange and provide jobs to Nigerian.

Some machinery and equipment that are used in leather, chemicals and other allied industries for the processing of abundant agricultural and natural raw materials in Nigeria have been produced. Presently NARICT has designed, developed and produced castor seed shelling machine molds. Soap production machines, lime motorized mixer, extruder, miller and cutting machine for a private sector industry. NARICT is also rendering consultancy services.

NARICT has develop four (4) tannery production centers with the capacity to produce various types of leathers, in Maduguri, Sokoto, Zaria. Footwear production unit is located at the Institute's Headquarters in Zaria (Basawa) and produces various types of leather goods such as briefcases, hand bags for ladies and gentlemen, children's school bags, belts, pouf, conference bags e.t.c it also has a well equipped workshop for the production of the above stated items and assorted types of footwear.

NARICT has also produced Tanni powder from Bagaruwa (acacia) and mangrove fatliquors. This is considered a major development in view of its potential utility in the tanning and leather trade.

## 4.2 ADMINISTRATIVE AND OPERATIONAL PROFILE OF I.A.R.

### 4.2.1 Historical Background of Institute for Agricultural Research (IAR)

The coming into effect of the Ahmadu Bello University (A.B.U.) Law on October 4, 1962 led to the birth of the Institute for Agricultural Research (I.A.R.), Samaru. Prior to the date, the Institute had existed for a span of forty years having

started in 1922 as the Headquarters of the defunct Department of Agriculture in the Northern provinces.

However, it is noteworthy to point out that the Institute (IAR) that was handed over to the newly established university in October, 1962 was high calibre having come a long way since 1925 when the first research laboratories were opened at the then Samaru Agricultural Station. The research staff strength had risen from six in the late 1920s to fifty when A.B.U. took over. (IAR, 1996)

Consequently, the thirteen status of the Ahmadu Bello University law established IAR, Samaru to be responsible for carrying out agricultural research for the northern state of Nigeria in cooperation with the Ministry of National Resources of each state and with other agricultural research stations in Nigeria, including those of the Federal Government.

### 4.2.3 Objective of I.A.R.

With the April 1987 re-organization of the national research system, the Institute for Agricultural Research (IAR) Samaru, has the following as its mandate:

a) Genetic improvement of sorghum, groundnut, cowpea, cotton and sunflowers.

b) Production of all agricultural food crops grown in the broad ecological zone covered by the present Sokoto, Kano, Bauchi, Kaduna, Katsina, Kebbi and Jigawa states in the aspects of:

i) Crops agronomy including cultivation, planting and harvesting methods
ii) Adaptation of introduced or improved crops varieties
iii) Developing and testing of pest and disease control measures
iv) Farming systems including integration of livestock, tree crops and agro forestry into production systems
v) Socio-economic problems of agricultural production, soil fertility and soil stabilization.
vi) Irrigation crops production

vii) Design and fabrication of simple agricultural implements and equipment.

The institute shall also:

a) Carry out agricultural extension liaison with relevant federal and state ministries, primary agricultural producers, industries and any other users of research results, within their zones in collaboration with the National Agricultural Extension Research Liaison Services (NAERLS). (IAR, 1996)

b) Organize technical and vocational courses in agricultural crops production and related fields within the zone.

c) Provide laboratory and other technical services to farmers, agro-based industries and others needing these services.

d) In carrying out its mandate, the institute shall collaborate with all other relevant research institutes and organizations

Source: IAR Printout 2005. Pg. 2.

### 4.2.4 Organizational Structure and Functions of IAR

With the present dispensation, IAR Samaru is still a part of a broad agricultural complex within Ahmadu Bello University. It has a unique organization in the sense that it is adjacent to the Faculty of Agriculture, A.B.U. Zaria. This was no accident but partly designed to ensure effective running of both the research and teaching activities of the institute and the faculty. Hence, most of the faculty staff perform dual roles, i.e. they participate in both teaching and research.

Consequently, all the teaching/academic staff members of the six Departments (Five within the Faculty of Agriculture (FOA) and one within the Faculty of Engineering (A.B.U) namely: Department of Agricultural Engineering, Agricultural Economics and Rural Sociology, Agronomy, Animal Science, Crop Protection and Plant Science are part and parcel of the institute.

Each of the six departments consists of specialist staff, the bulk of whom are recruited either specifically for teaching functions through the Faculty of Agriculture and financed by the National Universities Commission or for research and extension in IAR, Samaru through the Federal Ministry of Science and Technology (FMS&T) until March, 1992 and presently, the Federal Ministry of Agriculture and Natural Resources.

While Staff of the Institute and the faculty are housed within common disciplinary departments with the same head, research is organized on the basis of four crops programmes and these include:

(1) Cereals

(2) Legumes and out seeds

(3) Fibre and Horticultural crops and five supporting programmes namely,

(4) Farming systems,

(5) Agricultural mechanization

(6) Food science and technology

(7) Irrigation and

(8) Agricultural Extension services.

In order to enhance the rate of implementation of research programmes, strong service back-up units exist as part of the central administration of the institute, including an Agricultural Estate section as well as Data Processing Unit, Soil Experiment Unit and Account Unit.

According to the IAR, (1996) the IAR set-up is such that lends itself to the establishment of collaborative research protects with other national and international agricultural institutions as well as with donor agencies.

Administratively, the institute is under the close and direct supervision of the Ahmadu Bello University, Zaria.

### 4.2.5 Activities/strategies of IAR

Research policy of IAR is determined by the institute's Board of Governors and the research progrmme is drawn up and implemented with the assistance of the Professional and Academic (P & A) Board. Research in IAR is based on the consideration of agriculture as a whole system. Until the recent reorganization of the research institute in April 1987 which assigned Kaduna, Kano, Sokoto, Bauchi and Katsina States to the Institute as its area of mandate and moved the genetic improvement of kenaf, millet, wheat, barley and soybean to other institutes, the geographical area covered by IAR was about two-thirds of Nigeria, comprising the then ten northern states. As a result of the 1991 and 1996state creation exercises, the institute's mandate area now consist of Bauchi, Gombe, Plateau, Nassarawa, Jigawa,

Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara states. (IAR, 1996)

Research at the institute is organized on the basis of four crops and four supporting programmes until the re-organization mentioned above. They are the following:

i) Crop Programmes

a) Cereals: Sorghum, millet, maize, wheat and barley.

b) Legumes and Oilseeds: Cowpea, groundnut, bambara, soyabean, sesame, sunflower and castor.

c) Fibres: cotton, kenaf, roselie and jute.

d) Horticultural Crops: onion, pepper, ginger, tomato, citrus, mango, grapevine, melon, local vegetables and miscellaneous tree crops of the savanna.

ii) Supporting Programmes

e) Agricultural Mechanization: Including machinery technique evaluation, machinery/ technique development and machinery management.

f) Irrigation: Water resources development and management, irrigation cropping system and environment, implications of irrigation.

g) Food Science and Technology: Biological quality of food crops, local processing, industrial processing and monitoring of contaminants

h) Farming Systems: diagnostic surveys, on-station studies, on-farm studies and villages-level studies.

The necessary inter-disciplinary communication is achieved through research review committees constituted for each programme. Each programme is headed by a leader and the committee which he presides over comprises at least a breeder, an agronomist, a soil scientist, a crop protectionist, an agricultural engineer, an agricultural economist/rural sociologist and an extension specialist. Attendance of

meetings of the committee is open to all other members of IAR and NAERLS. The committees prepare for the approval of the Professional and Academic Board, research plans which reflect the priorities prescribed by the Board of Governors.

### 4.2.6 Agricultural Mechanization Research Programme.

1) Machinery Evaluation: Since a wide spectrum of assorted equipment is imported from all over the world, there was a felt need to assist in assessing such equipment under local conditions. Over 26 technical Test Reports on equipment imported or intended for importation have already been released. Such reports have been instrumental in stopping the importation of unsuitable equipment and have motivated manufacturers to make changes in their design to suit the local farming systems.

2) Development of equipment: The institute, as a step toward long-term solutions to mechanized equipment, has designed and fabricated many prototypes of machines which include:

   i) Manually operated maize Sheller: It has the potentials to give an advantage of more than 80% over hand shelling. Shelling capacity is about 25-35kg/hour.

   ii) Sorghum Thresher: Operated by about 1.5wk power unit, and a team of 2 labourers, it can give an output of about 100 kg/hour which is equated to the work performed by about 25 people per hour.

   iii) Groundnut decorticators: Manual and powered (2.5kw) machines, giving potential output of up to 200 kg/hour (with 2 operators) of shelled nuts, have been fabricated. This is a tremendous advantage when viewed against pure hand shelling with an output of about 1 kg/hour per person.

iv) Cowpea Sheller: A modification of the ove grounded Sheller. Clean cowpea about 200 kg/hour is possible.

v) Motorized Maize Sheller: A-3kw operated machine, shells maize in cobs (with husks) and clean grain at about 500 kg/hour is possible.

vi) Solar Crop drier: A variety of solar crop driers have been designed to suit different crops and are of different capacities. Reduction in drying time over natural sun-drying in the range of 50 to 200%, has been recorded.

vii) Others: Some other machines in the process of development include:

- Sunflower Sheller
- Sunflower decorticator
- Soybean thresher
- Cotton picker (manual)
- Tools specific to women operators
- Sugarcane extractor

viii) Multicrop thresher: A simple thresher, operated by about 2.5kw power source and capable of threshing and cleaning three important cereals (wheat, sorghum and millet), has been fabricated. Outputs up to 80kg/hour for wheat, 50 kg/hour for millet and 60 kg/hour for sorghum have been obtained using a 2-man crew and giving a large advantage over traditional threshing.

ix. Straddle row weeder: A high clearance animal drawn straddle row weeder has been developed to give advantage of weeding on ridge to a crop height of up to one metre. An area of one hectare can be covered in about 5 hours.

The design, fabrication and testing (AR prototype equipment, are generally directed at reducing human labour, facilitating farm operations, and at increasing output. A large proportion of the components are locally sourced and therefore, frequent breakdowns and grounding due to lack of spare parts, which is the common feature of imported machinery, would not arise.

As part of equipment development, a project on technology for women has recently been embarked upon in collaboration with the Ford Foundation. Activities undertaken thus far under the Technology for Women project include surveys of women food sellers; Fulani milk processing; problem of 'pepper-grinding' mills and grouping pattern of women in Kaduna State. Simultaneously, efforts have been embarked upon towards adapting and adopting some of IAR's existing prototypes to women group farmers at selected locations. In addition, engineering designs have been completed for the development of suitable water carrying devices as well as milk processing tools for Fulani women. (IAR, 1996)

### 4.2.7 Management of Equipment

The third aspect of the institute's Agricultural Mechanization Programme focuses on the need and rationale of proper management of agricultural equipment. Such studies have revealed, for instance, the field losses and unnecessarily excessive labour force employed in a machine like combination. Further problem of mismatching of equipment and the source of power are identified.

IAR, (1996) asserted that the Agricultural Mechanization Research Programme has also researched projects on crop losses and their prevention at levels from harvesting to storage. Projects on crop storage including usage of solar energy farm transport and human economics (human drudgery studies) have not been left out

either.

Breeding activities have led to the successive development of new cotton varieties, with the new succeeding varieties being always better than the preceding ones in terms of greater yield potential and lint quality. Recently, more attention is being given to insect pest tolerance and disease resistance, especially to the bacterial bright disease pathogen, in breeding endeavours. Several varieties have been developed and released as cultivars, namely: SAMCOT-1, SAMCOT-2, SAMCOT-3, SAMCOT-4, SAMCOT-5, SAMCOT -6, SAMCOT -7, SAMCOT -8, SAMCOT-9 AND SAMCOT – 10 Among recently released cotton varieties are SAMCOT -9 and SAMCOT – 10 whose yield potentials range from 2.5 – 3.0 tones/ha and the maturity period is between 130-150 days. They are resistant to bacterial blight and leaf spot disease.

SAMCOT -8 still remains the commercial variety in the eastern cotton-growing zone. The IAR conducts the initial multiplication of improved cotton varieties on her farm where the stage 1 foundation seed is produced. Further multiplication of seed is organized at the state level by the ADPs and Ministries of Agriculture under the general supervision of the National Seed Service and the IAR. (IAR, 1996)

### 4.2.8 Disease Control:

In addition to the current recommended seed dressing chemical (Bronocot), Apron Plus 50 DS, Marshal 25 STD and Rovral ST, singularly or in combination with Bronocot, have been shown to be effective for the control of seed and soil-borne disease and arthropods and to enhanced cotton production. Acid-dilinting cotton seed with concentrated sulphuric acid has also been shown to be effective in disease control and enhanced seedling emergency and stand establishment. Host plant

resistance studies have shown that the new cotton varieties, SAMCOT-9 and SAMCOT–10, are more resistant to bacterial blight (the major disease of cotton) than the current commercial varieties, SAMCOT-6 and SAMCOT-8

### 4.2.9 Fibre Technology.

The testing section of the fibre testing and spinning laboratory has been fully equipped to undertake full-scale testing of fibre characteristics, such as length, strength, fineness and the maturity on researchers' materials in IAR cotton from the breeding, agronomic and the crop protection aspects of the programme.

Ginning of researcher's materials from the different aspects of the programme is being done in the ginnery unit of the Institute's laboratory. Only the seed got from the foundation seed multiplication is being ginned by Cotton and Agricultural Processors Limited (CAPL), Zaria, in view of its quantity and when seed for distribution to farmers is required.

The new facilities have immensely enhanced immensely fibre testing work at IAR, where the four major fibre characteristic tests are being carried out. Some yarn testing equipment such as the wrap reel, lea strength tester and yarn fruition tester have been procured for the testing of yarns from the researchers' materials.

Research results have revealed that the application of nitrogen, phosphorus and boron and potassium fertilizer, in certain instances, will boost cotton yield provided the crops are planted early mid-June and protected against insect pests. Yield improvement through the application of the right quantities of fertilizer can be in the order of 50-70%. A record yield of 3.5 tonnes per hectare has been achieved from Samaru research plots under optimum input management.

A recent recommendation for chemical weed control in cotton in the Nigerian savanna zone consists of a combination of herbicide treatments capable of ensuring

effective early control of weeds, good crop growth and high seen cotton yield with consequent reduction in labour requirement. Yield advantage that can accrue from this recommendation is in the order of 30-65 per cent and overall labour savings are as high as 180 man-days per hectare.

A new interim recommendation for the chemical control of insect pests on cotton in the Nigerian savanna has recently been approved based on the comparatively better efficacies of Polytrin, Sherpaplus and Karate chemicals as pest control, their satisfactory control of the broad spectrum of pest attacking the crop and the consequently higher seed cotton yields. The cost-effectiveness of the new recommendation makes it a preferred option to the present recommendation.

**4.2.10 Fibre Entomology**

**Pests Control:**

**a) Cotton**

Insect pests infestation continues to be a major constraint to cotton production. There is a gradual changing role in the dynamic of the insect in the cotton – ago – ecosystem. Beside the bollworms which attach cotton fruits, other pests such as aphids and flea beetles continue to maintain high populations from year to year. Research efforts had actually revealed that Sylepta deaogata infestation on cotton leads to yield reduction.

A new pest control recommendation for the chemical control of cotton pests is at advanced stage of preparation. This involves the use of ultra-low-volume (ULV) and Emulsifiable Concentrate (EC) formulations of Polytrin (cypermethrim + profenofes), Shepa pus (cypermethrim + dimethoate ) and Karate (cyhalothrin). Three sprays of the insecticides starting 10 weeks after sowing will be required at a fortnight

interval. However, if S. deaogata is observed, the first insecticide spray required should be applied at between 1-8 weeks after sowing. This will effectively control the eggs and larvae of Sylepta.

**b) Kenaf**

Preliminary investigations of insect associated with kenaf showed a total of 136 different species of insects. Research effort had proved that kenaf protected against insect infestation at fruiting gave the best capsule yield. However, the best stem length, but diameter fibre and seed yield were obtained from plants protected at flowering.

**Kenaf Diseases and their Control**

The most important disease of kenaf, Hibiscus cannabinus L. is the Coniella lead spot induced by Coniella musaiaensis var. Hibisici B. Sutton. It could account for between 60 and 90 per cent defoliation if samples are taken in early September. Other diseases are the seedling rot induced by Fusarium spp. And occasionally, the basal is not induced by Scierotium rolfsii.

Investigations over the years have shown that foliar damage due to Coniella lead spot did not significantly reduce the fibre yield; it, however, reduced the seed and fodder yield significantly.

### 4.2.11 Disease Control

Field experimentation has shown that spraying Delsene M (Carbendazim + Meneb) and Benlate (benomyl) at fortnightly intervals as from six weeks after early-June – sown kenaf will control the disease.

Seed dressing with benomyl before sowing effectively controlled the seed not due to Fusarium attack. The incidence of basal rot is very minimal, occurring only in

years when the rainfall is heavy.

Kenaf: As a result of the transfer of the national mandate of the genetic improvement of kenaf from the IAR to the Institute of Agricultural Research and Training (IAR & T), Ibadan, some 57 germplasm materials which had been collected and maintained up till 1989 were handed over to the institute. Two improved selections made by the IAR from within the germplasm collection, namely Cuba 108 and Tianung No.1, have been found to be suitably adapted to the Nigerian environment and are expected to be used in the expected promotion and expansion of Kenaf production in Nigeria.

### 4.2.12 Food Science and Technology Research Programme

This programme determines the nutritional and biological value of IAR mandated crop cereals, grain legumes and horticultural corps. It is also involved in processing of selected crops, improvement in the technology of local food processing and monitoring of foods and feeds for toxic contaminants.

**a) Highlights:**

Improvement in nutritional quality of sorghum grain was achieved through malting. Experiments with animals showed that malted grains with roots and shoots have higher nutritive value than the unmalted grains and those without the vegetative parts. A 3.3 % increase in protein content of sorghum seed was obtained through irradiation of the seeds with gamma rays. The Sahelian sand dune sorghum germplasm was found to contain varieties with high seed protein contents ranging from 14.0 to 17.5%. Locally produced wheat flours form SAMWHIT -2 and SAMWHIT – 6 grains produced bread of comparable quality to the imported wheat flours. The technology for baking of bread from composite flours was demonstrated to bakers in Kaduna and

Kano municipalities. Contrary to widespread belief among the bakers, it was shown that good and acceptable bread can be baked from composite flour containing up to 30% non-wheat components without any significant change in the traditional baking equipment. (IAR, 1996)

**b) Nutritional Quality:**

**i) Sorghum:** Germination improved the nutritional quality of sorghum grains. Rabbits fed on diet containing whole malted grains gained more weight than those fed on either unmalted grains or malted grains without roots and shoots. This showed that the vegetative parts contain appreciable amounts of useful nutrients. However, the vegetative parts also contain high level of cyanide, a toxic compound. This was evident in the high levels of cyanide and thiocyanate in the urine, faeces and gastrointestinal compartments of the rabbits fed on whole malted grains.

Seeds of SAMWHIT -17 irradiated with gamma rays were advanced to M5. Out of 34Ms lines, 27 had higher protein content than the check SAMWHIT -17, while 7 had less amount of protein. Overall, a 3.3 % increase in protein was achieved as a result of the irradiation.

**ii) Millet**: The distribution of protein in the soluble fractions of early and late-maturing varieties of pearl millet was essentially similar. The prolamin fraction constituted the largest percentage (40%). Amino acid analysis showed that the albumin –globulin fraction contained higher levels of lysine than the eprolamin fraction.

The concentration of the albumin-globulin fraction was high in the early stages of seed development in the two varieties, but decline with increase in age. By development, the early-maturing variety showed faster initial accumulation of the prolamin fraction than the late maturing one.

**iii) Wheat**; Bakura-grown wheat possessed higher protein content average of (16.9 %) than kadawa-grown wheat (average 12.1%). However, grain yield at Bakura was lower than at Kadawa. Yield of flour was also higher at Bakura (average 66.3%) than a Kadawa laverage 57.3%) . The gluten of Bakura grown wheat flour was of higher quality than that of Kadawa. All these resulted in better baking quality of Bakura wheat flour, specific loaf volume was 3.4 and 2.95cm $^3$/g for Bakura and kadawa wheat flours respectively.

**iv) Groundnut**: Analysis of part of IAR groundnut germplasm gave a range of 35.5 to 57.1 % for oil and 12.2 to 24.9 % for protein. The oil and protein contents were negatively correlated to each other.

**v) Sunflower**: The oil and protein contents of IAR sunflower varieties were found to vary according to locations. At the location where oil content was highest, values ranged form 35.7 to 49.9 % with a mean of 43.8 %. Mean oil content from other two locations were 36.9 and 41.1 % respectively. The location with the highest oil content had the lowest protein content while the one with the lowest oil content had the highest protein content.

**vi) Local Vegetables (Okra)**: Significant effects of weed control treatments on viscosity of okra were observed. In one season, plots treated with a mixture of idphenamed with prometryne and pendimethalin plus terbutyne, each at 2kg and 1 kg a.i./ha produced okra fruits with significantly higher viscosity than all other treatments. In another season, fruits produced from plots treated with pendimethalin plus terbutryne at 2 + 1 kg a.i/ha followed by half of this rate at 3 weeks later resulted in significantly higher viscosity than all other treatment.

**c) Local Processing**

i) Sorghum: A locally developed mashing method designated "Ife mashing method" for the production of wort from malted sorghum resulted from the joint efforts between IAR programme and the Food Science Department of Obafemi Awolowo University. IIe-Ife. This is one of the local mashing methods developed for barley malt. The method was able to reduce cyanide content in the resultant sorghum wort by over 80% as compared to 92% for the conventional double decoction methods. Sorghum beer brewed using either of these methods contained a maximum of six microgram (6µg) of cyanide per 100ml. This is far below the 50 mg lethal dose of cyanide. In terms of cost, the Ife mashing method provided a cheaper alternative to the conventional methods for breweries still on the drawing boards. It was evident that for breweries already conditioned to use the conventional methods for barley malt, minor retooling can enable them use sorghum malt, for beer production.

ii) Wheat: IAR wheat cultivars with high baking qualities included SAMWHIT – 2, Pitic Gb x Yarta, SAMWHIT – 6 and Nacozari. Specific loaf volume of bread from these cultivars range from 3.6 to 4.3$cm^3g$ compared to 4.7 $cm^3g$ for the imported four. The total bread score for the IAR what cultivars range from 73 to 92% compared with 98% for important flour.

iii) Composite Flours: The technology for baking of bread from wheat composite flours was developed and demonstrated to bakers in Kaduna and Kano towns. The procedure involved bulk fermentation, knocking back of the fermented dough using the mixer, scaling moulding and baking at temperatures between 220-240oC. Best results were obtained using white maize and white sorghum Farafara. The local wheat varieties SAMWHIT -2 and SAMWHIT -6 compared favourably with imported wheat flours for the production of acceptable composite bread. The technology was tested in

commercial bakeries and composite flours containing up to 30% sorghum or maize were successfully used to bake bread of acceptable qualities. Generally, the wheat/sorghum bread was of higher specific loaf volume than the what/maize bread. Organoleptic evaluation within Samaru locality showed that the composite bread was acceptable to over 75% of the test population. The composite bread has a shorter shelf-life than 100% wheat bread.

**d) Industrial Processing:**

i) Wheat: The suitability of IAR wheat varieties for industrial milling was determined at one of Nigeria's leading flour mills. Extraction rate of 72.5% was obtained for SAMWHIT -2. Four other cultivar also had extraction rate of over 70%, namely, Junus and Nacozari (72.1% each), SAMWHIT -6 (71.9%) and SAMWHIT -3 (71.6%). The remaining cultivars had extraction rates in the range of 60.7 to 69.8%. the milling quality of most of the wheat cultivars tested was considered high.

ii) Beniseed-based food and feeds: Being exceptionally rich in methionine, beniseed has been used under laboratory conditions to fortify the protein content of snack and wearing foods for children. Preliminary consumer trial tests have shown that the food items compare favourably with those prepared with concentional ingredients. Indeed, in some cases, they were preferred by consumers to some snacks presently found in super andopen markets.

Similarly, preliminary results indicate that beniseed could be used as a local source of emhionine to supplement livestock feeds. Analysis of results from several trials shows that broiler chickens utilized and gained weight when fed with diets of maize + soybean meal and maize + cotton seed meal supplemented with beniseed cake at between 5-15%.

The importance of the study on beniseed lies on the fact that until recently, feed-mills have exclusively and increasing relied on the importance of synthetic methionine.

### 4.2.13 Horticultural Crops Research Programme

The programme aims at the identification and resolution of constraints in the way of self-sufficiency in the production and utilization of horticultural crops in the savanna zone. By so doing, it is hoped that the following benefits will accrue to the people and the national economy as a whole.

i) Improved nutrition, especially through adequate intake of essential minerals and vitamins.

ii) Supplemental and regular incomes for small scale growers.

iii) Production of fruits and vegetables for both the local and foreign fresh market trade.

iv) Increased production of raw materials for fruit and vegetable processing industries, and

v) Enhanced employment opportunities through the various tiers of production, processing and distribution.

**1. Tomato**: Tomato is an important ingredient in the diet of most Nigerians. Most of the usage is in the preparation of stews and soups as well as in admixtures with other food stuff during cooking to impart colour and favour. It is also an important industrial crop; four processing firms are currently wholly or partially engaged in the production of tomato products, especially paste.

Because several problems limit production, considerable quantities of processed tomato were imported annually, in 1978, over N25 million was expended in the importation of over 13 million kilograms of tomato puree/paste (Federal Office of

Statistics Lagos). The IAR, Samaru has conducted extensive research throughout the savanna zones into local adaptation, crop nutrition and other husbandry practices, crop protection and post-harvest handling of tomato. (IAR, 1996)

i) **Varietals Improvement**: The traditional tomato crop in Nigeria was predominantly of fresh market type most indeterminate, often misshapen, low in solid content and poor in handling and keeping qualities. The IAR has introduced about 1000 cultivars and lines of tomato from various parts of the world. On the basis of yield and quality of fruits, 16 cultivars (SAMTOM -1 to SAMTOM -16) were recommended for production in the savanna zones.

These cultivars, especially the processing types have been so well received in many areas of the northern states that farmers deliberately pull out rogue plants of local selections from the fields. The "Hausa tomato", as the improved varieties are described in the southern metropolitan areas where the bulk of the fruits are traded, is derived largely from IAR's tomato cultivars. This is available at IAR and 150 kg of seed has been provided in the last ten years to government agencies charged with seed production and to corporate and small-scale farmers.

ii) **Agronomic Practices**: Recommendations have been made in the following areas:

a) Fertilizers: A basal application of 300 kg/ha single superphosphate plus 160 kg/ha calcium ammonium nitrate or 00kg urea is recommended during land preparation. At 3 and 6 weeks after transplanting, calcium ammonium nitrate or urea is applied as a side dressing at the rate of 125 kg/ha or 70kg/ha respectively on each occasion.

b) Field layout plant spacing: In the wet season, tomatoes should be grown on raised beds while during the dry season under irrigation, sunken beds are preferred.

For most indeterminate varieties, double rows of 45 x 60cm Spacing is recommended.

c) Mulching/staking: Tomato production during the wet season requires either staking or mulching. We have recommended the use of grass mulch in the savanna as strakes are harder to come by.

d) Weed Control: The use of manual weed control is laborious, time-consuming, expensive and unreliable. Pre-and post-transplanting application of herbicides has been found to be a better alternative to the use of hand labour. In particular, mixtures of retribution with diphenamid, metolachlor or alachlor without supplementary hoe-weeding have been found to be very effective in tomato production.

**a) Chemical control to tomato leaf disease during the wet season:** The greatest limiting factor to tomato production in the wet season is leaf diseases. Research at IAR has shown, however, that the use of recommended fungicides is economical and the farmer who follows the recommended practices for tomato production in the wet season and applies fungicidal sprays of very low volume (VLV) captafol (Difolatan 80 wp of Difolatan 5 can obtain a new profit of at least N10,000/ha. With the disappearance of Difolatan from the local market, further research into alternatives has been intensified, so also has non-chemical control, especially breeding and selection disappeared. Already, lines with resistance to Septoria have been identified, of which TI 420 has been the most outstanding.

f) **Post-harvest technology**: IAR has conducted extensive studies into the effect of pre-and post-harvest practices on keeping quality of tomatoes for the purpose of local trade as well as for long distance transport. An appropriate choice of varieties and use of rigid packaging materials have been found to have a great impact on keeping quality.

**2. Onion**: Onion is a very important vegetable in Nigeria. In the north-western

savanna, growers annually obtain handsome profits from onion grown under irrigation. In a study conducted by the Sokoto Agricultural and Rural Development Authority in the early 1980s, a net return of N7,777 was obtained compared to a net return of N5,006 from wheat production. Research into onion improvement has focused on selection from local materials, irrigation scheduling, weed, insect pest and disease control, storage and seed production.

**i) Variety improvement**: IAR has developed six improved varieties of onion (SAMONI -1, SAMONI-2, SAMONI -3, SAMONI -4, SAMONI -5 and SAMONI -6) from local onion germplasm. They have a yield range of 10-35 tonnes/ha of bulb as well as good storage qualities when compared with local strains which are usually out-performed by as much as 60-72%.

**ii) Irrigation Scheduling:** Research results are available on optimum irrigation scheduling, amount of water to be applied to suit different soil types and stages in the life of the crop and irrigation shut off to enhance keeping quality.

**iii) Weed Control:** Weed control using hoes is an expensive, intensive, laborious and strenuous operation. It can also result in damage to the superficial and fragile root system. Because of this, IAR has recommended the use of the following herbicides, applied one or two days before transplanting:-

a) Oxadiazon (Ronstart 25EC) at the rate of 1.5-2.0 kg a.i/ha. This is equivalent to 6-8 i.ha of Ronstar 25Ec.

**b) Chlorthal dimethyle ester at 10kg a. i./ha of (Dacthal 75 wp at 13kg/a):** One hoe-weeding will be required following pretransplant herbicides. For large scale farmers, a number of post-transplant herbicides (acifluorfen, bentazone and bromoxynil) have also been recommended.

**vi) Disease Control:** Two major diseases, purple blotch and “twister” constitute

major limiting factors in the production of onion, especially during the wet season. A combination of contact and systemic funigicides e.g. benomyl (Benlate) and mancozeb (Dithane M-45) at 0.5 and 2.0 kg a.i/ha respectively has been found to effectively control both diseases.

**v) Insect Control:** The most serious insect problem on onion is that posed by thrips. Research has, however, established that a number of insecticides (e.g. carbaryl (Vetox 85) and synthetic pyrethroids (Cymbush, Decis) and insecticide formulations containing contact and systemic compounds (Symbush Super ED) are effective in trips control.

**vi) Low cost technologies for reducing storage losses:** IAR has developed a package with two important components:- pre-harvest (choice of varieties, crop husbandry, irrigation scheduling and shut off) and post-harvest (harvesting, curing, storage condition, inspection and sorting frequency) practices. The institute is also looking into cheap modifications of traditional storage structures which can bring about improved storability.

**3. Pepper:** Peppers are important commodities in both the domestic and international trade. Nigeria was once an important source of chilies on the world market. Currently there is a renewed interest in this crop.

**i) Variety Improvement:** Four new varieties of hot pepper with superioR&Desirable traits such as high yield, earliness and pungency have been developed and released for production in different savanna ecological zones of Nigeria. Two of these PL_2289 and P-Sakarho are among the pepper varieties being tested internationally under the auspices of the Asian Vegetable Research and Development Centre in Taiwan.

**ii) Weed Control:** The pepper plant has a very poor competitive ability with

weeds Research is under way to select suitable pre-transplant and post-transplant herbicides for weed control in peppers and already Galex at 3 kg a.i/ha has shown considerable promise.

**iii) Disease Control:** Several diseases of peppers e.g. pepper veinal mottle virus, leaf curl and wilt have been investigated and a number of approaches including cultural (time of planting, intercropping) chemical (use of insecticides to control insect vectors) and resistant varieties have been developed for mitigation losses from these diseases.

**4. Other Local Vegetables:** Several investigations into the optimum requirements for the production of other local vegetables e.g. spinach, eggplant and okra have been conducted. Based on the findings, advice can be given on such inputs as choice of varieties, manuring/fertilizer usage, disease and insect pest control. The specific case of flea beetle (prodagrica sp.) control in okra should be made. For this several effective and safe insecticides, e.g. carbaryl, (Vetox 85), cypermethrin (Cymbush) and cyhalothrin (Karate) have been identified.

**5. Ginger:** Ginger is an important cash crop, production of which has recently expanded form its traditional area in Southern Kaduna state to other parts of the southern Guinea savanna and forest zones. Some components of the appropriate technologies for the production of this crop e.g optimum set size, spacing, mulching, use of herbicides and manuring have been developed.

6. Tree Crops: Three tree crops: citrus, grape and mango have received considerable research emphasis.

7. Citrus: A number of high – yielding locally –adapted varieties have been identified. The cause organism of the very destructive brown spot disease which has caused a lot of concern in several states of the federatin has been identified as a

phaeoisariopsis sp. A recommendation for the control of the disease involving the spray application of benomyl (Benlate ) at the rate of 0.4 kg/ha (15g/10L of water ) once every 7 or 14 days has been made.

8. **Mango:** A number of high-yielding regular bearing varieties with good eating quality have been identified. A modified bench grafting technique suitable for the drier savanna has been developed. This technique shortens the length of nursery production of grafted seedlings from two to one year.

9. **Grape:** Grape is the latest entrant to IAR tree crops research. The Institute has already identified several varieties that are suitable for table, raisins, juice and wine. IAR established beyond any reasonable doubt that Nigeria can produce enough grapes to substitute for imported grape products especially wine.

IAR has technically backstopped grape-vine production in Nigeria. As far back as the 1960s, the institute conducted trials on the local production of the crop which is basically a templerate climate crop. Through intensive selection, the Institute has identified about 22 varieties of grapes with average yields of 15-20 tonnes/ha, including those suitable for food, raising, juice and wine. At present IAR has successfully adapted and popularized the crop in Nigeria, particularly in the savanna ecological zones.

### 4.2.14 Impact of the Programme on the lives of Nigerian

**1.** Farmers are now growing more fruits and vegetables of a better quality and with higher yields all the year round and are earning very good returns.

2. There is an increase in the consumption of fresh vegetables and fruits with the attendant of general improvement in the health of citizens.

3. Improved sourcing of local raw materials has resulted in considerable import substitution in cases such as tomato paste and mango juice preparation.

4. There are excellent opportunities for growing a number of horticultural corps to earn foreign exchange. Examples of these are pepper, okra, ginger, mango and grape.

5. Processing firms have increased in number, using as raw materials pepper, tomato, mango etc. these provide employment at all tiers of production, processing, transportation and retailing.

### 4.2.15 Government Support for IAR

#### a. Funding

Following the voluntary withdrawal of the Federal Military Government in October 1979, an elected civilian administration took over. The Federal Ministry of Science and Technology created in the same-year was changed with the promotion and co-ordination of research results.

In 1984, the ministry was merged with the Ministry of Education to form the Federal Ministry of Education Science and Technology.

In 1985, the Federal Ministry of Science and Technology (FMS&T) was re-established. IAR Samaru has remained as one of the premier research institutes under this ministry.

There were (as at 1991) above 26 research institutes under the ministry out of which 19 are agriculture related (AR) Samaru being a leader, until the recent reorganization exercise at the federal ministries which placed IAR Samaru under the Federal Ministry of Agriculture and Natural Resources, Abuja (Federal Capital Territory) along with about 17 other agriculture-based research institutes.

Research activities are under the direction of a Board of Governors which is responsible for making policy guidelines within the specified functions of the institute, assigning priorities for research activities within the capacity of funds

allocated and approving the budget to support the research plans before they are submitted to the ministry in Abuja.

Following the re-organization of research institutes in 1993, IAR Samaru's funding was transferred to the Federal Ministry of Agriculture and National Resources, Abuja along with 18 other agriculture-based research institutes.

**Table 4.3 shows the budget allocation to IAR for the year 1998-2008**

| | CAPITAL FUNDING | | | RECURRENT FUNDING | | |
|---|---|---|---|---|---|---|
| **YEAR** | **BUDGET(APPR)** | **ACTUAL (RELEASES)** | **RELEASE AS % OF APPROVED BUDGET** | **BUDGET (APPR)** | **ACTUAL (RELEASES)** | **ACTUAL RELEASES AS % OF APPROVED BUDGET** |
| 1998 | 24,000,000.00 | 6,000,000.00 | 25.0 | 35,225,348.00 | 58,531,978.00 | 166.16 |
| 1999 | 35,500,000.00 | 10,400,000.00 | 29.3 | 384,429,852.00 | 111,910,356.06 | 29.11 |
| 2000 | 226,046,239.00 | 24,899,377.00 | 11.02 | 121,417,402.40 | 190,768,520.99 | 157.12 |
| 2001 | 133,261,389.00 | 12,988,109.07 | 9.75 | 371,682,311.00 | 257,451,467.98 | 69.27 |
| 2002 | 570,045,112.00 | 41,704,372.00 | 7.32 | 570,045,776.00 | 297,468,947.01 | 52.18 |
| 2003 | 444,405,112.00 | 4,603,903.08 | 1.04 | 536,695,299.00 | 277,357,938.00 | 51.69 |
| 2004 | 606,717,185.80 | 723,907.56 | 0.12 | 533,558,168.00 | 263,127,288.99 | 49.32 |
| 2005 | 82,878,800.00 | 61,250,257.00 | 73.90 | 604,311,420.00 | 321,244,519.98 | 53.16 |
| 2006 | 296,343,661.00 | 28,875,144.50 | 9.4 | 503,109,220.00 | 510,054,207.00 | 101.38 |
| 2007 | 35,000,000.00 | 21,000,000.00 | 60.00 | 557,182,166.00 | 554,334,034.00 | 99.49 |
| 2008 | 478,999,212.00 | 354,572,027.00 | 74.02 | 728,908,455.00 | 314,073,926.00 | 43.09 |
| Total | 2,933,196,710.80 | 567,017,097.21 | 27.38 | 4,946,5417.00 | 3,156,323,184.0 | 79.27 |

**Source: IAR, Zaria (1996)**

**b. Funding Problem**

A cursory look at Table 4.3, it is readily obvious that funding of IAR during the period under review was inadequate. For example actual amount received from the federal budget in 1998 for capital programmes projects was 25% of the approved budget for the year, and apart for 1999 in which the percentage rose to 29.3, in subsequent years up to 2004 the percentage declined steadily reaching 0.12% in 2004. The highest percentage of 74.02 was recorded in 2008. The average percentage released for the period was 27.4% which was barely over a quarter.

The recurrent releases at 79.27% of the approved budget were much better but were still less than the amount approved in the period under review.

Funding had been a major problem in IAR. There should be increase in funding as research anywhere is expensive. In IAR, it was discovered from the interview with the Secretary to the Institute that out of the small amount of budget allocation funds meant for research and procurement were lumped together, and this can cause misplacement of priorities. Apart from funding challenges there are other challenges.

### 4.2.16 Challenges of the Programme in IAR

1) The greatest curtailing factor to the programme is the failure of the relevant federal ministries to officially accord due recognition to the immense contributions which the programme has made to the development of horticultural crops in the savanna zones of Nigeria. This has consequently resulted in very poor funding of the programmed research. As the primary horticultural establishment catering for the research needs of growers of fruits and vegetables in the north –

western zone of the savanna, a zone with acknowledged comparative advantage.

2) The programme lacks adequate bilateral and multilateral linkages within and outside Nigeria.

### 4.2.17 Irrigation Research Programme

The main objectives of the programme are as follows:-

1) To identify appropriate techniques for water resources development and management such as water storage, conveyance systems, application methods and drainage for efficient use of water in agriculture.

2) To develop suitable methodology for efficient management of soil-water-crop environments for sustained crop production including irrigation scheduling, identification and development of suitable cropping systems and irrigated analysis of various aspects of irrigated agriculture.

3) To develop suitable preventive and curative measures for environmental hazards associated with faulty irrigation systems such as soil salinity, water-logging, weed insect pest and disease build-up, and environmental pollution.

Some of the activities and progress made over the years are discussed below:

i) Water resource development: The mode of prediction of potential evapotranspiration has been developed and tested; its prediction is more accurate than earlier models used by River Basin Authorities. This will improve the calculation of project water requirement.

A standard hydrograph for northern Nigerian water-sheds has been established using soil infiltration and simple rain gauge records.

The methodology has been worked out to predict soil loss through erosion from the knowledge of the sheer strength of the soil, it will avoid the use of physical labour for

soil loss measurement for curative purpose.

ii) Irrigation system design: Several standards of sprinkler irrigation such as coefficient of uniformity, efficiency, spacing, riser length and water line pressure have been worked out. These standards are superior to the ones previously used by the project. This will reduce the maintenance cost and increase the yield up to 40 per cent. Parameters developed for surface irrigation (Border, Basin and Furrow) save 20 to 20 per cent water against various losses.

Channel lining methodology developed and material identified save cost of water conveyance. Every 500-M lined channel in this new way would develop sufficient water to irrigate one ha additional land. The design procedures have been developed to ascertain the break even points for use of open line canal vis-à-vis underground pipe for dry condition. The prototype of the device for measuring water in open field channel has been fabricated. This endures the desired amount of water to be applied at the farm level.

iii) Drainage systems and design: A rise of ground water table at the rate of one centimeter per year in Kano River Project was established. This is an indication of severe hazards that could develop by wasteful use of water. Drainage specifications for Kano project area have been determined for efficient and less expensive drainage systems. Use of bamboo as drainage material has been identified as the cheapest locally available material for drainage and substitute for several petrol fiber and metallic materials.

iv) Irrigation scheduling: Irrigation scheduling for wheat has been perfected for three major irrigation schemes namely Bakolori, Kano River and Chad Basin Irrigation Projects. The amount and time of irrigation identified are to provide 20-30 per cent higher water use of efficiency and yield than previously used, without

any danger of environmental hazard. Maize, onion and barley crops are becoming popular in Bakolori and Kano River Projects. A more efficient irrigation scheduling for these crops has been worked out and their production packages have been developed.

v. Irrigated soil Management: Under medium textured soil the minimum tillage was found to be comparable to conventional tillage and this would ultimately save the energy requirement of the cropping systems.

The optimum fertilizer required for wheat has been recommended for various irrigation frequencies. Micronutrients are also becoming an important factor in affecting the crop yields as research has indicated in Bakolori and Kano project areas. The zinc application will be required for rice, maize, wheat and onion crops to obtain high yield.

vi. Cropping pattern for irrigation projects: Several wheat-based and cotton-based combinations of crops profitable for crops which are rotations for various types of farmers have been suggest. It has been proved that as much as three crops per year could be profitable patterns for Nigerian irrigation schemes, where water is very expensive.

Time of planting of crops in irrigation scheme has been found to be most crucial. Delay by few weeks in planting, may result in 50-60 per cent yield reduction. Optimum timing for wheat and maize has been determined.

vii) Farmer –managed irrigation projects.

Engineering studies were aimed at determining the efficiency, distribution and use of water. Both the main system and on-farm water distribution were monitored. The study concentrated on three sectors , namely Kadawa Arore and Kore sectors, in Kano River project KRP), Kdawa and one irrigation district of Bakolori Irrigation Project

(BIP) , Talata Mafara.

For the agronomic studies, farmers were selected at both KRP and BIP for crop yield performance studies during the dry season. Farms were selected based on the location (head, middle and tail) along the canal (main, lateral, distribution and field canals). With the use of questionnaire, farmers, participants, observation and district measurement techniques, data involving overall system, performance were collected.

From the socio-economic studies, data collected and analyzed on resource utilization, yields, roles of farmers and project management in operation and maintenance and the effectiveness of farmer's organizations, models have been developed to turnover some of the management responsibilities of large scale irrigation projects from the River Basin Development Authority (RBDA) to the farmer during the first phase of study. These models will bring about a management structure in which RBDAs, along with other government agencies, such as credit institutions, rural development and extension agencies, join hands with farmers in managing the irrigation projects. The proposal for the second phase "verification and adoption of jointly (farmer and authority managed irrigation technology" has been submitted to the Ford Foundation for funding.

**ACHIEVEMENTS OF THE OBJECTIVES OF IAR**

The Institute for Agricultural Research was established for a number of reasons which are achieved through the following objectives:

**Objective 1;** IAR has been able to develop and release 38 varieties of sorghum to date. It offers a wide range of choices to the producers in the central ecological zones of Nigeria in terms of adoption, height and time of maturity. These varieties (SAMSORG – I to SAMSORG 38) have yield potentials ranging

between 1.5-3.0 tones/ha.

Hybrid sorghum that will possess desirable characteristics to satisfy not only industrialists but also home user is also being developed and the work is almost completed.

IAR, with collaboration with IITA/CEC has made progress in the development of maize varieties with medium maturity (70-85 days) and varieties that are adoptable to mid altitude areas of the Northern Savanna.

IAR has been able to work out a complete production package which many farmers are now adopting with a high level of success.

IAR has also developed chemical control of the devastating maize streak virus disease, Unchecked crop losses due to Severe attack by this disease could be as high as 100% and, as a result, farmers often avoid growing maize in some cropping seasons.

IAR has also devoted much effort to groundnut research. While the average yield of unimproved varieties on farmers field is about 600-700kg/ha, the improved varieties developed at IAR yield as much as 2,500-3,500 kg/ha and even more with proper crop husbandry and management.

In addition to improved varieties that have been previously released to farmers, IAR has recently released the following varieties of ground-nut for production in Nigeria`s Sudan and Guinea Savanna ecological zones.

**Ground-nut varieties for production:**

**S**udan Savanna and part of Northern Guinea Savanna

a. **Original name** : 55-437(Ex-Dakar) Recommended name :SAMNUT-14

Characteristics: Highly drought- tolerant

High- yielding. Yield potential

2.7 t/ha moderately resistant to green rosette but highly susceptible to chlorotic rosette and leaf spot.

b. **Ground-nut varieties for production in Northern and Southern Guinea Savanna Zones.**

RMP-12 (SAMUT-10) Characters: Highly resistant to strains of GVR and to leaf spots yield potential 3.7 t/ha matures 133- 141 days.

c. **Design and fabrication of simple agricultural implements and equipment**.

**Development of equipment**

The Institute as a step toward long-term solutions to mechanized equipment has designed and fabricated many prototypes of machines which can be fabricated locally. Some of these machines are:

1. **Manually operated maize Sheller**: Has the potential to give an advantage of more than 80% over hand shelling. Shelling capacity is about 25-35 kg/hour.
2. **Sorghum thresher**: Operated by about 1.5 kw power unit, and a team of 2 labourers. It can give an output of about 100kg/hour which is comparable to work performed by about 25 people per hour.
3. **Groundnut Decorticators:** Manual and powered (2.5 kw) machines, giving potential output of up to 200 kg/hour (with 2 operators) of shelled nuts, have been fabricated. This is a tremendous advantage when viewed against pure hand shelling with an out put of about 1kg/hour per person.
4. **Cowpea Sheller**: This is a modification of the ova groundnut Sheller. Clean cowpea about 200 kg/hour is possible.
5. **Solar crop dries:** A variety of solar crop driers have been designed to suit

different crops and at different capacities. It has recorded a reduction of drying time over natural sun- drying, in the range of 50 to 200%. Other machines in the process of development include:

a. Sunflower Sheller
b. Sunflower decorticator
c. Soybean thresher
d. Cotton picker (Manual) e.t.c.

## 4.3 Conclusion

From our findings and the analysis of the data, we have come to the conclusion that the problems of the two research institutes used as case studies have similar problems of inadequate funding and irregular release of fund, thereby jeopardizing their effective operations. It also means that human capital development would not have received the attention it deserved.

Furthermore, looking at Table 4.3 it can also be deduced that lack of funds for training of the research staff has led to poor performance. However, it can be observed that in view of its core mandates of developing the technologies required by the chemical industry, NARICT has achieved significant results. For instance, in the period under review, NARICT successfully completed project in the production of bat, fat liquor, crude papin from carrica papapya, essential oils from plants like caplytus. It has also designed and fabricated castor seed shelling machine, constructed klin and burners for hydrated lime plus affluent treatment plants from natural and synthetic materials. Similarly, IAR has also succeeded in its area of core mandate; for instance it has developed hybridized seedlings, which have enhanced agricultural production among farmers especially in northern Nigeria. Its extension services have

also ensured that famers benefit from modern and high-yielding agricultural techniques which have the potential of helping Nigeria to realize its goal of providing food for all and thereby stopping its reliance in the importation of food. However, a gap exists in the effective communication of these achievements by NARICT and IAR to the general public, such that entrepreneurs could take advantage of the products available at the two institutes. This will have the advantage of providing additional source of funding for further research.

# CHAPTER FIVE

# DATA PRESENTATION AND ANALYSIS OF FINDINGS

## 5.0 Introduction

This chapter is concerned with the presentation and analysis of data gathered through the use of both primary and secondary sources. This include questionnaires administered at the National Research Institute for Chemical Technology (NARICT) and Institute for Agricultural Research (IAR) Samaru, Zaria as the main case study in addition to the Federal Ministry of Science and Technology (FMST) Abuja and Federal Ministry of Agricultural and Rural Development where interviews were also conducted for the purpose of this study.

This chapter is therefore central in the research process given its focus on revealing the extent to which the data collected from the field supported or disagreed with a particular line of reasoning.

In line with the above, the chapter is sub-divided into five sections, section: one deals with the introduction while two focuses on questionnaire administration analysis, sections three, four and five indicate the analysis of data as they relate to hypothesis one, two and three respectively. This chapter is ends with a summary of the major findings of the study.

## 5.1 Data Presentation and Analysis

### 5.1.1 Demographic Characteristics of Respondents

**Table 5.1: Summary of population, Sampling Techniques and Sample Size of Respondents**

| Name of Institute or Ministry | Drawn sample of Questionnaire Administered | Number of Questionnaire retrieved | Number of Questionnaire duly completed | Percentage |
|---|---|---|---|---|
| NARICT | 58 | 57 | 57 | 98 |
| FMST | 58 | 42 | 42 | 67 |
| FMWR | 58 | 57 | 57 | 98 |
| IAR | 58 | 53 | 53 | 76 |
| **Total** | **232** | **209** | **209** | |

*Source:* Survey by Researcher, 2010.

The rate of Return = $\frac{\text{Total number of Questionnaire retrieved}}{\text{Total sample size drawn}} \times \frac{100}{1}$

$= \frac{209}{232} \times \frac{100}{1} = 90.08\%$

The rate of Response = $\frac{\text{Total number of Questionnaire completed}}{\text{Total sample size drawn}} \times \frac{100}{1}$

**Table 5.2.2 Sex distribution of respondents**

| Category | Frequency | Percentage |
|---|---|---|
| Female | 99 | 47.4 |
| Male | 110 | 51.6 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

From the table above, 99 (47.4%) of the respondents are female while 110 (51.6%) of the respondents are male. This therefore indicates that adding together the total respondents from the institutes and ministries considered, we can deduce that there are more male staff than female. The reason as observed is that more male are involved in rigorous research than female.

**Table 5.2 Educational Qualification**

| Category | Frequency | Percentage |
|---|---|---|
| No formal Edu. | 18 | 8.6 |
| Primary Edu. | 33 | 15.8 |
| SSCE | 12 | 5.7 |
| OND/NCE | 55 | 36.3 |
| HND/Degree | 76 | 36.4 |
| Others | 14 | 6.7 |
| No response | 1 | 0.5 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 18 (8.6%) of the respondents have no formal

education, 33 (15.8%) have only primary education, 12 (5.%) are holders of SSCE, 55 (36.3%) has OND/NCE while 76 (36.4) are holders of HND/Degree and 14 (6.7%) have other qualifications higher than the first degree. However, it could be deduced that most of the staff are educated, this is indicated by 55 (36.3%) and 76 (36.4%) of the total respondents who have educational qualifications ranging from OND and above. The fact that only 6.7% have degrees higher than the first degree/HND, explained our earlier hypothesis that these institutions suffer from inadequate expertise/staff who are competent in conducting research for instance, those holding Ph.D. degree are more knowledgeable in research with relevant experts than staff with first degrees and HND.

**Table 5.3 Respondents Rank**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Junior Staff | 68 | 32.5 |
| Senior Staff | 138 | 64.6 |
| No response | 6 | 2.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, shows that 68 (32.5%) of the respondents are junior staff while 138 (64.6%) are senior staff. This therefore means that there are more senior staff in the institutes and ministries under study, but a few of them are engaged in research while, the majority are in administration.

**Table 5.4 Respondents' Years of Service**

| Category | Frequency | Percentage |
|---|---|---|
| 1-10yrs | 35 | 16.7 |
| 11-20yrs | 52 | 24.9 |
| 21-30yrs | 64 | 30.6 |
| 31 years and above | 55 | 26.3 |
| No response | 3 | 1.4 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, indicates that 35 (16.7%) of the respondents have served for between 1-10 years, 52 (24.9%) have served for 11-20 years, 64 (30.6%) have worked for 21-30years while 55 (26.3%) have 31 years and above working experience. This indicates that majority of the respondents have put in a good number of years in their various places of work, but with limited or little outcome in terms of productivity.

## 5.2 Test of Hypotheses

For the purpose of this research study, a number of hypotheses have been drawn in chapter one. To approve or disapprove these hypotheses, certain variables have been drawn where respondents are expected to react or respond to these variables.

### 5.2.1 Answering Research Question One

**Have NARICT and IAR succeeded in providing indigenous raw materials for industrial technology in Nigeria?**

To answer this research question one questionnaire items 8 – 17 were designed to elicit responses to this question

.

**Table 5.5 Function of NARICT and IAR are not achieving result.**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 40 | 19.1 |
| Agree | 119 | 56.9 |
| Undecided | 16 | 7.7 |
| Disagree | 23 | 11.0 |
| Strongly disagree | 2 | 1.0 |
| No response | 9 | 4.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, clearly shows that 40 (19.1%) of the respondents strongly agreed that NARICT and IAR are achieving result in their respective mandates, 119 (56.9%) equally agreed that the functions are achieving results, 23 (11.0%) disagreed with this assertion, 2(1.0%) strongly disagreed, 16 (7.7%) were undecided while 9 (4.3%) of the total respondents did not respond. It could be deduced that these institutes and ministries is achieving significant results based on the total response of 142 (76%) from a total respondents of 209.

The interviews conducted with the Director General of NARICT and the Secretary to the Institute of IAR was in line with the response from the questionnaires that indicated that NARICT and IAR were achieving result. In addition, the Deputy Director, Ministry of Science and Technology also agreed that the two organizations are achieving the purpose for their establishment..

**Table 5.6 Government commitment in the implementation of the Science and Technology Policy is sufficient.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 15 | 7.7 |
| Agree | 36 | 17.2 |
| Undecided | 36 | 17.2 |
| Disagreed | 49 | 23.4 |
| Strongly disagreed | 65 | 31.1 |
| No response | 8 | 3.8 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above revealed that 49 (23.4%) of the respondents strongly disagree that the government commitment towards achieving the functions of NARICT and IAR is adequate, 65 (31.1%) also strongly disagreed with this, 15 (7.2%) strongly agreed, 36 (17.2%) agreed, another 36 (17.2%) of the respondents were undecided while about 8 (3.8%) did not response.

However, from the table, it can be seen that 114 (54.5%) out of the total respondents of 209 attested to the fact that government commitment in the implementation of science and technology is not adequate. This, therefore means that the research institutions have not been given the right or power to operate effectively and also increase their performance.

However, the responses from the interviews conducted with the Director of Research and Development in NARICT and the Deputy Director of Research in IAR were not contrary to the responses from the questionnaires that indicated that government commitment in achieving the functions of science and technology policy of the two institutions is not sufficient. For example the levels of funding and training in the institutes are inadequate. From the observation made by the researcher it also confirmed that the staff were not happy about government's commitment in achieving the functions of the organizations.

**Table 5.7 NARICT and IAR have achieved their mandates given by the Federal Ministry of Science and Technology.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 20 | 9.6 |
| Agree | 24 | 11.5 |
| Undecided | 10 | 4.8 |
| Disagree | 76 | 36.4 |
| Strongly disagree | 66 | 31.6 |
| No response | 13 | 6.2 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above showed that 20 (9.6%) strongly agreed that NARICT and IAR had achieved the mandates given them as stipulated in the instrument establishing them. 24 (11.5%) equally agreed, 76 (36.4%) strongly disagreed with this assertion, 66 (31.6%) also disagreed, 10 (4.8%) shows undecided while 13 (6.2%) indicated no response.

Based on the activities of research institutes in the country, especially when

compared with their counterparts in developed countries (e.g USA and UK) other developing countries( India and Brazil), one may be tempted to deduce that the research institutes in Nigeria have not done enough in terms of breakthrough in the area of science and technological development. This can equally be ascertained by 142 (68.0%) out of a total of 209 respondents who strongly disagreed and disagreed with the assertion.

**Table 5.8 Government Financial Allocation to Research Institution is Sufficient in the Implementation of Science and Technology**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 29 | 13.9 |
| Agree | 39 | 18.7 |
| Undecided | 32 | 15.3 |
| Disagree | 64 | 30.6 |
| Strongly disagree | 38 | 18.2 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, indicates that 29 (13.9%) of the respondents strongly agreed that government financial allocation is enough to enable NARICT and IAR to perform their functions effectively in the implementation of the science and technology policy, 39 (18.7%) also agree with this fact, 32 (15.3%) were undecided, 64 (30.6%) of the respondents disagreed with this while 38 (18.2%) strongly disagreed to it and about 7 (3.3%) indicated no response.

From the table, it can be said that the financial allocation of government to these institutions is not adequate in the implementation of the science and technology

thereby rendering their performance ineffective. This is based on the majority of the respondents who indicated disagree and strongly disagree for the implementation of science and technology policy.

**Table 5.9 Staff of NARICT and IAR are well trained in their respective disciplines locally and abroad for the implementation of science and technology policy.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 18 | 8.6 |
| Agree | 40 | 19.1 |
| Undecided | 33 | 15.8 |
| Disagree | 76 | 36.4 |
| Strongly disagree | 35 | 16.7 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, depicts that 18 (8.6%) strongly agree that the staff of NARICT, FMST, FMARD and IAR are well trained in their respective disciplines locally and abroad. 40 (19.1%) also support the view, 33 (15.8%) were undecided, 76 (36.4%) disagree, 35 (16.7%) strongly disagree that their staff are well trained in their respective disciplines locally and abroad while 7 (3.3%) did not respond.

However, from the responses, the majority of the staff did not support this assertion; 111 (53.1%) out of the total respondents of 209 disagreed and strongly disagreed meaning that their staff do not get the desired training they deserve to enable them perform adequately. As a matter of fact, for a research institution to have a breakthrough in science and technological development, staff training should be handled as a matter of priority in the implementation of science and technology

policy.

**Data showing training and retraining of staff.**

**Table 5.10 Analysis of the responses to questions on the monitoring of the Performance of NARICT and IAR**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 33 | 15.8 |
| Agree | 65 | 31.1 |
| Undecided | 24 | 11.5 |
| Disagree | 60 | 28.7 |
| Strongly disagree | 16 | 7.7 |
| No response | 11 | 5.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

Observation from the table above shows that 33 (15.8%) of the respondents strongly agreed that lack of monitoring of NARICT and IAR affected the implementation of government's science and technology policy. 65 (31.1% also agree, 24 (11.5%) were undecided, 60 (28,7%) disagreed, while 16 (7.7%) strongly disagree and about 11 (5.3%) of the respondents indicated no response. Out of 209 respondents, 98 (46.9%) strongly agreed and agreed. Therefore we can deduce that lack of monitoring of research institutions affects the implementation of science and technology policy.

**Table 5.11: Analysis of the responses to question on the level of foreign technology transfer on the implementation of science and technology policy in Nigeria.**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 45 | 21.5 |
| Agree | 95 | 45.5 |
| Undecided | 26 | 12.4 |
| Disagree | 24 | 11.5 |
| Strongly disagree | 10 | 4.8 |
| No response | 9 | 4.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above, shows that 45 (21.5%) strongly agree that the level of technological transfer is relatively low, 95 (45.5%) agree that the technological transfer is low, 26 (12.4%) were undecided, 24 (11.8%) strongly disagreed with this assertion, 10 (4.8%) also disagreed, while 9 (4.3%) indicated no response. However, it can therefore conclude that the level of technological transfer is low judging from the 140 (67.0%) out of the total of 209 respondents that agree with this assertion.

**Table 5.12 Analysis of the responses to question on the impact of the level of government on science and technology policy in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 118 | 56.5 |
| Agree | 63 | 30.1 |
| Undecided | 18 | 8.6 |
| Disagree | 6 | 2.9 |
| Strongly disagree | - | - |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicted that 118 (56.5%) of the respondents strongly agreed that more government investment in research institutions would enhance better performance in the implementation of the science and technology policy, 63 (30.1%) equally agreed that more investment would result to better performance in the implementation of science and technology policy, 18 (8.6%) were undecided, 6 (2.9%) disagreed while 4 (1.9%) indicated no response. From the table, out of a total of 209 respondents, 181 (86.6%) confirmed that more government investment would equally lead to better output. Investment should be directed to the acquisition of state of the art analytical equipment and human capital development.

**Table 5.13 Analysis of the responses to question on the effect of using unqualified officers on the implementation of science and technology policy in Nigeria**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 33 | 15.8 |
| Agree | 58 | 27.8 |
| Undecided | 23 | 11.0 |
| Disagree | 64 | 30.6 |
| Strongly disagree | 26 | 12.4 |
| No response | 5 | 2.4 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above shows that 33 (15.8%) of the respondents strongly agreed that the lack of qualified research officers is a function of poor performance in Nigeria, 58 (27.8%) also agreed or supported this, 23 (11.0%) indicate undecided, 64 (30.6%) disagreed, 26 (12.4%) strongly disagreed with this assertion while 5 (2.4%) did not respond to the question. It is imperative to note that in a situation where research

officers are not given the right attention in the area of training it will indirectly affect their performance and productivity. Therefore, it will be appropriate to say that unqualified research staff affect the performance of research institutions in Nigeria in the implementation of its science and technology policy as is indicated on the table by a total of 91 (43.6%) out of 209 respondents.

**Table 5.14 Analysis of the responses to question on the role of government finance in science and technology policy implementation in Nigeria.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 39 | 18.7 |
| Agree | 67 | 32.1 |
| Undecided | 30 | 14.4 |
| Disagree | 52 | 24.9 |
| Strongly disagree | 14 | 6.7 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above reveals that 39 (18.7%) strongly agree that government's role in financing the activities of research institutions in Nigeria, is not sufficient 67 (32.1%) were in support, 30 (14.4%) could not decide, 52 (24.9%) disagreed with the assertion and 14 (6.7%) strongly disagreed with it, while 7 (3.3%) did not respond to the question. However, we quite understand clearly that any organization that does not have sufficient government financial support and evaluation may not perform well, therefore it will not be far-fetched to say that the government's role also affects the performance of the institutes and this can be seen from Table 45.14, where out of 209 respondents, 106 (50.8%) indicated that government's role in financing the activities

of research institutions in the country and the implementation of science and technology policy is not sufficient.

### 5.2.2 Answering Research Question Two

**To what extent have NARICT and IAR contributed to the development of the indigenous raw materials in the areas of chemical, leather and agricultural industry?**

. In order to ascertain or assess the actual implementation of science and technology policy, the respondents were requested to react to questions relating to the implementation of the science and technology policy in the light of the provision of high quality chemicals, leather and agricultural products at affordable rate.

**Table 5.15. The Result of the Performance of NARICT in the implementation of government's science and technology policy.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 16 | 13.8 |
| Agree | 45 | 38.8 |
| Undecided | 11 | 9.5 |
| Disagree | 43 | 37.0 |
| Strongly disagree | 1 | 0.9 |
| No response | 0 | - |
| **Total** | **116** | **100** |

*Source:* Survey by Researcher, 2010.

**Table 5.15 The Result of the Performance of IAR in the implementation of government's science and technology policy.**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 15 | 16.1 |
| Agree | 40 | 43.0 |
| Undecided | 10 | 10.8 |
| Disagree | 20 | 21.5 |
| Strongly disagree | 4 | 4.3 |
| No response | 4 | 4.3 |
| **Total** | **93** | **100** |

The table above shows that 16(13.8%) and 15(16.1) from NARICTS and IAR respectively strongly agreed in the result above, 45(38.8%), 40(43%) of NARICTs and IAR respectively equally agreed on the result. 11(9.5%) from NARICTS, 10(10.8%) from IAR disagreed on the outcome of the result, 1(0.9%), NARICTS, 4(4.3%) IAR strongly disagreed, while 4(4.3%) were undecided from IAR. However, from the table we can see that a total of 116 (55.5%) out of the 209 respondents have shown positive response in the result on NARICT and IAR in the implementation of government's science and technology policy. This therefore explained the fact that majority of the respondents are of the view that NARICT and IAR have made significant progress in Nigeria's science and technology drive.

**Table 5.16 Analysis of the responses to question on the strategies of NARICTs and IAR to support inventions and innovation in the implementation of science and technology in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 6 | 2.9 |
| Agree | 94 | 45.0 |
| Undecided | 33 | 15.8 |
| Disagree | 69 | 33.0 |
| Strongly disagree | 4 | 1.9 |
| No response | 3 | 1.4 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above indicates that 6 (2.9%) of the respondents strongly agree that the strategies adopted by NARICT, FMST, FMARD and IAR to encourage invention and innovation are adequate in the implementation of Nigeria's science and technology policy, 94 (45.0%) also agreed or supported, 33 (15.8%) were undecided, 69 (33.0%) disagreed, 4 (1.9%) strongly disagree with the assertion while 3 (1.4%) did not respond. From the table a total of 100 (47.9%) out of 209 respondents have agreed that the institutions and ministries are doing their best to encourage invention and innovation in the country.

**Table 5.17 Analysis of the responses to question on government support for production in the implementation of science and technology policy in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 41 | 19.6 |
| Agree | 98 | 46.9 |
| Undecided | 36 | 17.2 |
| Disagree | 29 | 13.9 |
| Strongly disagree | 1 | 0.5 |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above shows that 41 (19.6%) of the respondents are of the opinion that government has supported production in Nigeria through NARICT and IAR. 98 (46.9%) also agrees with the claim, 36 (17.2%) were undecided, 29 (13.9%) disagreed, 1 (0.5%) strongly disagreed while 4 (1.9%) indicated no response.

Looking at the table, one would accept the fact that government is really giving support in production through these institutions based on the fact that 139 (66.5%) respondents out of a total of 209 have agreed to the opinion.

**Table 5.18: analysis of the responses to question on the level of technological development in Nigeria through NARICT and IAR**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 37 | 17.7 |
| Agree | 81 | 38.8 |
| Undecided | 40 | 19.1 |
| Disagree | 38 | 18.2 |
| Strongly disagree | 9 | 4.3 |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above reveals that 37 (17.7%) of the respondents strongly agreed that there is some level of technological development in Nigeria through the activities of NARICT and IAR, 81 (38.8%) also agreed, 40 (19.1%) were undecided, 38 (18.2%) did not agree, 9 (4.3%) strongly disagreed while 4 (1.9%) showed no response.

However, the responses depict that out of a total respondents of 209, 118 (56.5%) agreed that there is some level of technological development in the Nigeria through NARICT and IAR. This therefore means that the research institutions and the ministries are working towards enhancing scientific development in Nigeria in the implementation of the country's science and technology policy which will enhance the production of high quality products from NIRICT and IAR.

**Table 5.19 analysis of the responses to question on the effect of NARICT and IAR activities on the overall economy of Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 31 | 14.8 |
| Agree | 40 | 19.1 |
| Undecided | 12 | 5.7 |
| Disagree | 64 | 30.6 |
| Strongly disagree | 52 | 24.9 |
| No response | 10 | 4.8 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 31 (14.8%) of the respondents strongly agree that the activities of NARICT and IAR have some effect on the overall economy of the country, 40 (19.1%) also agreed, 12 (5.7%) were undecided, 64 (30.6%) disagreed that the institutes' activities have a high effect on the overall economy of Nigeria, 52 (24.9%) strongly disagreed while 10 (4.8%) indicated no response.

From the table, out of 209 respondents, 116 (55.5%) disagreed that these institutes do not have high effect on the overall economy of the country through the implementation of the country's science and technology policy because of the poor quality of products. It can be deduced that the percentage of the contributions these institutes in contributing to the overall economy of Nigeria is low. Therefore, our earlier postulation of inadequate funding of research institution is justifiable base on the responses from the field. Generally, the problem of funding, expertise, incentive for staff, furnished laboratories etc are hindrance to effective performance of NARICT and IAR. In interviews with the authorities of these institutions, there is clear demonstration of this problem. However, the table below explains the situation

**Table 5.20 Analysis of the responses to question on the problem militating against the achievement of NARICT and IAR in the implementation of science and technology policy in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 49 | 23.4 |
| Agree | 92 | 44.0 |
| Undecided | 32 | 15.3 |
| Disagree | 20 | 9.6 |
| Strongly disagree | 9 | 4.3 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 49 (23.4%) of the respondents strongly agree that NARICT and IAR have problems militating against the achievement of their mandate of the implementation of Nigeria's science and technology policy, 92 (44.0%) equally agreed or were in support of it, 32 (15.3%) were undecided, 20 (9.6%) disagreed, 9 (4.3%) strongly disagreed while 7 (3.3%) indicated no response. Therefore based on the findings, 141 (67.4%) out of the 209 respondents were of the belief that these institutes have problems militating against their achievement of the implementation of the nation's science and technology policy.

**Table 5.21: Analysis of the responses to question on the current performance of NARICT and IAR in the implementation of science and technology policy in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 57 | 27.3 |
| Agree | 95 | 45.5 |
| Undecided | 31 | 14.8 |
| Disagree | 22 | 10.5 |
| Strongly disagree | - | - |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

Table 5.21 indicates that, 57 (27.3%) respondents believed that the current performance of the research institutes is due to the implementation of Nigeria's science and technology policy, 95 (45.5%) equally supported this fact, 31 (14.8%) were undecided, 22 (10.5%) disagreed while 4 (1.9%) indicated no response. However the findings, showed that 152 (72.8%) out of the 209 respondents agreed that the performance of the research institutes is positive in relation to the implementation of the nation's science and technology policy.

Many research institutes in Nigeria still operate with obsolete policies which are not meeting the challenges of contemporary research. Therefore, it is necessary for the policy makers to reform NARICT and IAR in order to meet modern techniques in research. These reforms can be organizational, operational and systematic. In fact, the table below attests to this fact.

**Table 5.22: analysis of the responses to question on the science and technology policy reforms on the performance of NARICT and IAR**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 118 | 56.5 |
| Agree | 67 | 32.1 |
| Undecided | 16 | 7.7 |
| Disagree | 6 | 2.9 |
| Strongly disagree | - | - |
| No response | 2 | 1.0 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

From the table above, it depicted that 118 (56.5%) strongly agree that our research institutions need some reforms in order to perform better, 67 (32.1%) equally agreed, 16 (7.7%) could not decide on this, 6 (2.9%) respondents disagree while 2 (1.0%) indicated no response. From the table, out of 209 respondents, 185 (88.6%) agree that the research institutes need some level of reform to ensure better performance. This means that, like other parastatals, the research institutions in Nigeria's need reforms in order to perform better in the implementation of science and technology policy. In summary therefore, this can be done by policy makers regularly visiting the research institutions in order to assess their compliance to the policy. This means that the policy makers should be more committed to ensuring the implementation of the nation's science and technology policy of government.

**Table 5.23: Analysis of the responses to question on the adequacy of facilities and equipment in the research institutes in Nigeria**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 46 | 22.0 |
| Agree | 73 | 34.9 |
| Undecided | 29 | 13.9 |
| Disagree | 48 | 23.0 |
| Strongly disagree | 9 | 4.3 |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above indicates that 46 (22.0%) of the respondents strongly agreed that the rate of facilities and equipment in Nigeria's research institutions is above average, 73 (34.9%) also agreed to this fact, 29 (13.9%) were undecided, 48 (23.0%) of the respondents disagreed that the research institutes should be rated high in terms of facilities and equipment, 9 (4.3%) strongly disagreed while about 4 (1.9%) showed no response.

From the table, 119 (56.9%) out of 209 respondents indicated that the research institutes can be rated high in terms of facilities and equipment. This therefore means that the research institutes are in better position to perform better and increase their level of output, considering their facilities and equipment in the implementation of Nigeria's science and technology policy.

### 5.2.3 What are the inherent challenges that hinder the success of science and technology in NARICT and IAR?

Questionnaire items 27 to 36 were designed to illicit answers to this research questions

To proof or disapprove this, the respondents are expected to react to the following variables. NARICT and IAR like any other institute in Nigeria is under the direct supervision of the ministry. It is difficult for the institutes to be financially independent and thereby lack certain autonomy in taking responsibilities. Again, researches are conducted with approval from the ministry. This can cause delay in achieving research result. The table below explains.

**Table 5.24 Analysis of the responses to question on the impact of the adequacy of autonomy granted to NARICT and IAR**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 65 | 30.6 |
| Agree | 70 | 33.5 |
| Undecided | 24 | 11.5 |
| Disagree | 45 | 21.5 |
| Strongly disagree | 2 | 1.0 |
| No response | 4 | 1.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 65 (30.6%) strongly agreed that the level of autonomy granted to NARICT and IAR is adequate, 70 (33.5%) equally agreed or were in support of it, 24 (11.5%) were undecided, 45 (21.5%) disagreed that the autonomy is not adequate, 2 (1.0%) strongly disagreed with this while 4 (1.9%)

showed no response. From the analysis, out of the 209 respondents, 135 (64.1%) indicated that the level of autonomy given to these institutions and ministries is adequate to enable them operate as independent entities without any recourse to the government.

These institutes based on the findings, are not completely autonomous as the influence of the ministry continue to exist. In most cases, directives and policies are a creation of the ministry. Therefore, it is absolutely difficult for the institutes to exercise any power on certain critical issues. This places the institutes in a position of being subordinate to the ministry.

**Table 5.25: analysis of the responses to question on NARICT and IAR are not autonomous.**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 25 | 12.0 |
| Agree | 39 | 18.7 |
| Undecided | 9 | 4.3 |
| Disagree | 83 | 39.7 |
| Strongly disagree | 46 | 22.0 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above shows that 25 (12.0%) believed that NARICT and IAR are completely autonomous, 39 (18.7%) were in support, 9 (4.3%) were undecided, 83 (39.7%) disagreed, 46 (22.0%) strongly disagreed with this assertion while 7 (3.3%) indicated no response. Out of the 209 respondents, 129 (61.7%) were in disagreement with this assertion this therefore means that these institutions do not possess complete autonomy but are still under the control of the Federal Government. In our earlier

hypothesis, it was stated that the problem of these institutes is lack of expertise. This simple technical knowledge is limited in the institutes. The table confirms this position.

**Table 5.26: Analysis of the responses to question on the impact of the level of expertise available in NARICT and IAR on output**

| **Category** | **Frequency** | **Percentage** |
|---|---|---|
| Strongly agree | 56 | 26.8 |
| Agree | 64 | 30.6 |
| Undecided | 10 | 4.8 |
| Disagree | 67 | 32.1 |
| Strongly disagree | 6 | 2.9 |
| No response | 6 | 2.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 56 (26.8%) of the respondents strongly agreed that there exist in the institutes low level of expertise, 64 (30.6%) equally agreed, 10 (4.8%) were undecided, 67 (32.1%) disagreed, 6 (2.9%) strongly disagreed while 6 (2.9%) showed no response. However, the table above shows that out of the 209 respondents, 120 (57.4%) believed that these institutes suffer from technical knowledge often brought about by expertise mostly from foreign countries. Most of the staff in this institute have little or no knowledge in conducting independent research. Secondly, the institutes are populated with supporting staff who are mainly involved in routine administration. The table below captures the situation.

**Table 5.27 Analysis of the responses to question on the number of experienced staff in NARICT and IAR**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 53 | 25.4 |
| Agree | 83 | 39.7 |
| Undecided | 3 | 1.4 |
| Disagree | 33 | 15.8 |
| Strongly disagree | 30 | 14.4 |
| No response | 7 | 3.3 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above shows that 53 (25.4%) of the respondents strongly agreed that there is low level of experienced staff in the two institutes. 83 (39.7%) also agree on this, 3 (1.4%) were undecided, 33 (15.8%) disagreed with this fact, 30 (14.4%) strongly disagreed while 7 (3.3%) indicated no response. From the responses, we understand that out of 209 respondents, 136 (65.1%) agreed that experienced staff are less than the inexperienced staff.

In every organization, the central issue is to achieve certain objectives. In the cases under review, the objectives are threatened by the unavailability of experienced staff. The table below is necessary.

**Table 5.28 analysis of the Reponses to question on the impact of inexperienced staff in NARICT and IAR.**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 41 | 19.6 |
| Agree | 80 | 38.3 |
| Undecided | 6 | 2.9 |
| Disagree | 53 | 25.4 |
| Strongly disagree | 23 | 11.0 |
| No response | 6 | 2.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

From the table above, it is revealed that 41 (19.6%) of the respondents strongly agreed that the objectives of NARICT and IAR are being affected by the existence of inexperienced staff. 80 (38.3%) were in support of this views, 6 (2.9%) were undecided, 53 (25.4%) disagreed, 23 (11.0%) strongly disagreed while 6 (2.9%) showed no response. Out of the 209 respondents, 121 (57.9 %) have agreed that NARICT and IAR are finding it difficult to achieve their objectives as a result of experienced staff to manage certain key areas of research.

NARICT and IAR which are deeply involved in research are not the major employees of labour rather it is the ministry. It is more appropriate for the institutes to employ directly because they know the services which required from the expertise.

**Table 5.29: Analysis of the responses to question on the best way to improve the performance in NARICT and IAR**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 49 | 23.4 |
| Agree | 81 | 38.8 |
| Undecided | 6 | 2.9 |
| Disagree | 26 | 12.4 |
| Strongly disagree | 32 | 15.3 |
| No response | 15 | 7.2 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above depicts that 49 (23.4%) of the respondents strongly agree that NARICT and IAR should be involved in employing their expertise 81 (38.8%) equally agreed with this position, 6 (2.9%) were undecided, 26 (12.4%) disagreed, 32 (15.3%) strongly disagreed while 15 (7.2%) simply indicated no response. Based on the number of respondents on the table, out of the 209 respondents, 130 (62.2%) believed that the institutes directly employed relevant expertise in their areas of interest. This will enhance their strategy to use research result to the advantage of the Nigerian economy.

**Table 5.30: Analysis of the responses to question on the effect of absolute autonomy of research institutes on the security of the country**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 32 | 15.3 |
| Agree | 46 | 22.0 |
| Undecided | 7 | 3.3 |
| Disagree | 47 | 22.5 |
| Strongly disagree | 48 | 23.0 |
| No response | 29 | 13.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above indicates that 32 (15.3%) of the respondents strongly agreed that absolute autonomy to research institutions in Nigeria will pose a problem to the country's security, 46 (22.0%) also agreed to this view, 7 (3.3%) were undecided, 47 (22.5%) disagreed, 48 (23.0%) strongly disagreed while 29 (13.9%) indicated no response. Looking at the table, it could be understood that out of 209 respondents, 95 (45.5%) of the respondents were of the view that absolute autonomy of the research institutes in the country would not threaten the security of the country.

When absolute autonomy is granted to research institutions in the country, it may threaten the security of the country in that they can involve themselves in certain production that will expose the security of the state. In some countries research relating to chemical weapon and ammunition are often made without the knowledge of the government.

It is generally believed by some individuals that some sectors of the economy is better managed by privatizing them, e.g. Telecommunication, that research institutes may perform better when privatized.

**Table 5.31: analysis of the responses to question on the effect of privatization of Research institutes on their performance**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 55 | 26.3 |
| Agree | 61 | 29.2 |
| Undecided | 6 | 2.9 |
| Disagree | 27 | 12.9 |
| Strongly disagree | 36 | 17.2 |
| No response | 24 | 11.5 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

The table above reveals that 55 (26.3%) of the respondents strongly agreed that privatization of research institutions is the solution for better performance, 61 (29.2%) equally support this view, 6 (2.9%) could not decide on this view, 27 (12.9%) disagreed, 36 (17.2%) strongly disagreed while 24 (11.5%) did not respond. From the view of the respondents, it is easy to understand that the majority of the respondents believed that research institutes in the country should be privatized for better performance. This view is revealed by 116 (55.5%) out of a total of 209 respondents.

**Table 5.32: Analysis of the responses to question on the Federal Ministry of science and technology monitors research institutes for implementation of the policy.**

| Category | Frequency | Percentage |
|---|---|---|
| Strongly agree | 36 | 17.2 |
| Agree | 97 | 46.4 |
| Undecided | 17 | 8.1 |
| Disagree | 19 | 9.1 |
| Strongly disagree | 34 | 16.3 |
| No response | 6 | 2.9 |
| **Total** | **209** | **100** |

*Source:* Survey by Researcher, 2010.

From the table above, it is depicted that 36 (17.2%) of the respondents strongly agreed that the ministry of science monitors research institutes in order to ascertain their effectiveness, 97 (46.4%) also agreed to this fact, 17 (8.1%) were undecided, 19 (9.1%) disagreed, 34 (16.3%) strongly disagreed while 6 (2.9%) respondents did not respond to the question.

However, from the table, out of a total of 209 respondents, 133 (63.6%) indicates that the ministry of science and technology is really monitoring research institutions in the country in line with their mandate to ensure increased performance and effectiveness.

### 5.3.1 Test of Hypothesis 1

***The implementation strategy of the National Policy of Science and Technology does not add significant value to the performance of NARICT and IAR.***

A chi-square was performed on this hypothesis to test for the level of significance between the variables used in the hypothesis testing. Below is the table showing the cross tabulation.

1. Variable 9 VS 13

Variable 9: The level of Government commitment in achieving the mandate of NARICT, AND IAR is sufficient.

Variable 13: Lack of monitoring of NARICT and IAR affect the implementation of Science and Technology Policy.

**Table 5.33**

Variable 13

| **Variable 9** | **SA** | **A** | **UD** | **DA** | **SD** | **No response** | **Total** |
|---|---|---|---|---|---|---|---|
| SA | 9 | 10 | 5 | 7 | 3 | 2 | **36** |
| A | 6 | 16 | 5 | 29 | 7 | 2 | **65** |
| UD | 4 | 12 | 3 | 13 | 3 | 1 | **36** |
| DA | 12 | 16 | 11 | 7 | 2 | 2 | **49** |
| SD | 2 | 10 | 0 | 2 | 1 | 0 | **15** |
| No response | 0 | 1 | 0 | 2 | 0 | 5 | **8** |
| **Total** | **33** | **65** | **24** | **60** | **16** | **11** | **209** |

From the above, we could be observed that 98 people both from NARICT and IAR agreed that lack of monitoring has affected the implementation of the science and technology policy, the percentage that agreed are more than the percentage that disagreed, so we would accept that NARICT and IAR are not properly monitored.

**Table 5.34 Results of Chi-square Tests ($X^2$) performed**

| | Value | Df | Asymptotic Significance |
|---|---|---|---|
| Pearson Chi-square | 92.248 | 25 | 0.000 |
| Likelihood ratio | 61.837 | 25 | 0.000 |
| Linear-by-linear association | 7.318 | 1 | 0.007 |

**Hypothesis**

**Ho: there is no significant relationship between the performance of the research institution and government.**

H1: there is significant relationship between the performance of the research institutions and government.

**Chi-square Test**

$X^2$ tabulated is 0.05 (5%) = 14.6

$X^2$ calculated is 0.000

**Decision Rule**

Accept $H_o$ if $X^2_c < X^2_t$

Reject $H_o$ if $X^2_c > X^2_t$

$X^2_c$ (0.000) < $X^2_t$ (14.6)

Since $X^2$ calculated is less than $X^2$ tabulated ($X^2_c$ 0.000 < $X^2_t$ 14.6) we accept our null hypothesis and conclude that there is no significant relationship between the performance of the research institution and government and that government commitment in achieving the mandate of NARICT, FMST, FMARD and IAR is not sufficient.

In addition, in order to make our test still adequate, we have tested also at 1% (0.01) and 10% (0.1) and found out that there is no relationship at this level of

significance.

2. Variable 11 VS 13.

Variable 11: Government financial allocation to NARICT and IAR is sufficient in the implementation of Nigeria's Science and Technology Policy.
VS

**Variable 13: Lack of monitoring of NARICT, and IAR affect the implementation of science and technology policy.**

**Table 5.35**

Variable 13

| **Variable 9** | **SA** | **A** | **UD** | **DA** | **SD** | **No response** | **Total** |
|---|---|---|---|---|---|---|---|
| SA | 10 | 7 | 1 | 9 | 1 | 1 | **29** |
| A | 0 | 12 | 6 | 17 | 2 | 2 | **39** |
| UD | 4 | 8 | 10 | 4 | 6 | 0 | **32** |
| DA | 8 | 24 | 5 | 22 | 2 | 3 | **64** |
| SD | 11 | 13 | 2 | 7 | 5 | 0 | **38** |
| No response | 0 | 1 | 0 | 1 | 0 | 5 | **7** |
| **Total** | **33** | **65** | **24** | **60** | **16** | **11** | **209** |

Table 5.36 Results of Chi-square Tests ($X^2$)

| | **Value** | **Df** | **Asymptotic Significance** |
|---|---|---|---|
| Pearson Chi-square | 117.454 | 25 | 0.000 |
| Likelihood ratio | 83.198 | 25 | 0.000 |
| Linear-by-linear association | 9.166 | 1 | 0.002 |

$X^2$ tabulated is 0.05 (5%) = 14.6

$X^2$ calculated is 0.000

**Hypothesis**

Ho: there is no significant relationship between the performance of the research institutions and how the government allocation to NARICT, and IAR is adequate to perform their functions.

Hi: there is significant relationship between the performance of the research institutions and how the government allocation to NARICT, and IAR is adequate to perform their functions.

Since $X^2$ calculated < $X^2$ tabulated, we accept our null hypothesis (Ho) and conclude that there is no significant relationship between the performance of the research institutions and how the government allocation to NARICT and IAR is adequate to performance of their functions. That is to say that government's allocation to NARICT and IAR in the performance of their functions and therefore not significant at 1% (0.01) and 10% (0.10).

### 5.3.2 Test of Hypothesis 2

***Inadequate funding of research institutes such as NARICT and IAR contributes to the low quality of products in those institutes***.

Below is the table showing the cross tabulation:

1. Variable 9 VS 24

Variable 9: Government commitment in the implementation of Science and Technology policy is not sufficient.

VS

Variable 24: The current performance of the research institutes is inadequate in relation to the implementation of the science and technology policy of government.

**Table 5.37 shows degree of responses by respondents**

| **Variable 9** | **SA** | **A** | **UD** | **DA** | **SD** | **No response** | | **Total** | |
|---|---|---|---|---|---|---|---|---|---|
| SA | 12 | 16 | 5 | 0 | 0 | 1 | | **36** | |
| A | 18 | 30 | 11 | 5 | 0 | 2 | | **65** | |
| UD | 9 | 14 | 6 | 6 | 0 | 0 | | **36** | |
| DA | 10 | 27 | 6 | 6 | 0 | 3 | | **49** | |
| SD | 7 | 5 | 2 | 1 | 0 | 0 | | **15** | |
| No response | 1 | 3 | 1 | 1 | 0 | 5 | | **8** | |
| **Total** | **57** | **95** | **31** | **22** | **0** | **4** | | **209** | |

Government implementation of science and technology policy is not sufficient which means the policy is not well implemented. From the above table, we could observed that 152 people both from NARICT and IAR agreed that government's implementation of the science and technology policy is not sufficient and that is the reason for the low production of high quality chemicals, leather and agricultural products are poor. The percentage of respondents that agreed is more than the percentage that disagreed. It can therefore be rightly asserted that science and technology policy in NARICT and IAR is not fully implemented

**Table 5.38: shows Chi-square Tests ($X^2$)**

| | **Value** | **df** | **Asymptotic Significance** |
|---|---|---|---|
| Pearson Chi-square | 33.346 | 20 | 0.031 |
| Likelihood ratio | 19.309 | 20 | 0.502 |
| Linear-by-linear association | 8.069 | 1 | 0.005 |

The production of high quality chemicals, leather and agriculture industry is poor.

$X^2$ tabulated is 0.05 (5%) = 10.9

$X^2$ calculated is 0.031

$X^2_c$ (0.031) < $X^2_t$ (10.9)

The $X^2ca<X^2$ $^{is}$ tabulated at 5% (0.05) level of significance. That is to say that the implication of this policy is not sufficient that is why the production of high quality chemicals, leather and agriculture industry is poor.

2. Variable 19 VS 24

Variable 19: The strategies adopted by NARICT and IAR to support inventions and innovations are sufficient.

VS

Variable 24: The current performance of research institute is in relation to the implementation of the science and technology policy.

**Table 5.39 shows degree of responses by respondents Variable 24**

| **Variable 19** | **SA** | **A** | **UD** | **DA** | **SD** | **No response** | **Total** |
|---|---|---|---|---|---|---|---|
| SA | 4 | 0 | 1 | 0 | 0 | 1 | **6** |
| A | 23 | 48 | 15 | 8 | 0 | 0 | **94** |
| UD | 8 | 15 | 5 | 5 | 0 | 0 | **33** |
| DA | 22 | 30 | 10 | 7 | 0 | 0 | **69** |
| SD | 0 | 2 | 0 | 2 | 0 | 0 | **4** |
| No response | 0 | 0 | 0 | 0 | 0 | 3 | **3** |
| **Total** | **57** | **95** | **31** | **22** | **0** | **4** | **209** |

From the above table, we could observe that 152 people both from NARICT and IAR agreed that the current performance of NARICT and IAR is in relation to how science and technology policy is being implemented. The percentage that agreed are more than the percentage that disagreed it can be asserted that the performance of NARICT and IAR is in relation to the implementation of the policy.

**Table 5.40: shows Chi-square Tests ($X^2$)**

| | **Value** | **df** | **Asymptotic Significance** |
|---|---|---|---|
| Pearson Chi-square | 181.572 | 20 | 0.000 |
| Likelihood ratio | 52.230 | 20 | 0.000 |
| Linear-by-linear association | 27.750 | 1 | 0.000 |

Ho: Policies on science and technology have not shown any significant impact on the two research institutes.

H1: policies on science and technology have not shown any significant impact on the two research institutes.

$X^2$ tabulated is 0.05 (5%) = 10.9

$X^2$ calculated is 0.000

$X^2_c$ (0.000) < $X^2_t$ (10.9)

The chi-square result shows that $X^2_c < X^2_t$. This result reveals that the policy on science and technology had not shown any significant impact on the two research institutes.

### 5.3.3 Test of Hypothesis 3

***The attainment of the objectives of the National Policy on Science and Technology is a function of the caliber of staff in the research institutes.***

1. Variable 24 VS 30

Variable 24: the current performance of the research institutes in relation to the implementation of science and technology policy.

VS

Variable 30: Lack of experts is responsible for low output in NARICT and IAR

**Table 5.41 shows the degree of responses by the respondents**

Variable 30

| **Variable 24** | **SA** | **A** | **UD** | **DA** | **SD** | **No response** | **Total** |
|---|---|---|---|---|---|---|---|
| SA | 3 | 19 | 12 | 20 | 2 | 1 | **57** |
| A | 4 | 27 | 28 | 31 | 2 | 3 | **95** |
| UD | 1 | 11 | 10 | 7 | 2 | 0 | **31** |
| DA | 0 | 7 | 6 | 9 | 0 | 0 | **22** |
| SD | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| No response | 2 | 0 | 0 | 0 | 0 | 2 | **4** |
| **Total** | **10** | **64** | **56** | **67** | **6** | **6** | **209** |

From the above table, we could observe that 74 people both from NARICT and IAR agreed that lack of experts is responsible for the low output of the two institutes. The percentage that agreed are more than the percentage that disagreed. therefore, it so we could be said that employing more adequate scientists will increase the output of NARICT and IAR.

**Table 5.42 shows Chi-square Tests ($X^2$)**

| | Value | df | Asymptotic Significance |
|---|---|---|---|
| Pearson Chi-square | 60.542 | 20 | 0.000 |
| Likelihood ratio | 32.609 | 20 | 0.037 |
| Linear-by-linear association | 3.016 | 1 | 0.082 |

Ho: NARICT and IAR do not have the expertise to facilitate independent research with concrete result that will promote development in Nigeria and beyond.

H1: NARICT and IAR have expertise to facilitate independent research with concrete result that will promote development in Nigeria and beyond.

$X^2$ tabulated is 0.05 (5%) = 10.9

$X^2$ calculated is 0.000

$X^2_c$ (0.000) < $X^2_t$ (10.9)

From our result, $X^2$ calculated is less than $X^2$ tabulated using 0.05% level of significance. We therefore, accept the hypothesis that NARICT and IAR lack expertise to facilitate independent research with concrete result that will promote development in Nigeria and beyond. This is because from the table the highest percentage goes to strongly agree and agree.

2. Variable 24 VS 33

Variable 24: the current performance of the research institutes is in relation to the implementation of government's science and technology policy.

VS

Variable 33: The best way to improve the performance of NARICT and IAR is to allow the institutes to employ expertise

**Table 5.43 shows degree of responses by respondents Variable 33**

| Variable 24 | SA | A | UD | DA | SD | No response | Total |
|---|---|---|---|---|---|---|---|
| SA | 22 | 16 | 6 | 6 | 7 | 0 | **57** |
| A | 13 | 46 | 13 | 13 | 7 | 3 | **95** |
| UD | 6 | 13 | 8 | 4 | 0 | 0 | **31** |
| DA | 8 | 6 | 5 | 3 | 0 | 0 | **22** |
| SD | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| No response | 0 | 0 | 0 | 0 | 1 | 3 | **4** |
| **Total** | **49** | **81** | **32** | **26** | **15** | **6** | **209** |

From the above table, we could observe that 130 respondents both of NARICT and IAR agreed that the best way to improve the performance of NARICT and IAR is to allow the institutes employ experts. The percentage of agreement is higher than the percentage that disagreement. It can therefore be asserted that NARICT and IAR should be allowed to employ their own experts instead of their ministries employing for them.

**Table 5.7.12 shows Chi-square Tests ($X^2$)**

| | Value | Df | Asymptotic Significance |
|---|---|---|---|
| Pearson Chi-square | 107.302 | 20 | 0.000 |
| Likelihood ratio | 57.388 | 20 | 0.000 |
| Linear-by-linear association | 20.799 | 1 | 0.000 |

Ho: The research institutes were not allowed the freely employ expertise to manage key sectors of their research.

H1: The research institutes were allowed to freely employ expertise to manage key sector of their research.

$X^2$ – Tabulated is 0.05 = 10.9

$X^2$ – Calculated is 0.000

$X^2_c$ (0.000) < $X^2_t$ (10.9)

The Value of the result shows that $X^2_c < X^2_t$, therefore we will accept the hypothesis that the research institutes were not allowed to freely employ experts to manage key sectors of their research.

## 5.4 Discussion of Findings

The evaluation of the National Policy on Science and Technology is a sensitive issue when it comes to decision making process regarding science and technology in Nigeria. The National policy in this context refers to the entire range of government activity directed at science and technology. It is a set of objectives, aims, regulations, instruments, commitments and aspirations all of which involve the promotion of a set of goals.

The general findings of this study showed that the policy of science and technology has not affected NARICT and IAR to a large extent. This finding is in line with Wangwe (1992) who asserts that the policy of science and technology had shown low value in all African countries than in other parts of the world. This is as a result of the poor knowledge of its weak technical institutions (Richman, 1977). One of the reasons for lack of success is lack of financial commitment from government (Dahlman, 1989).

The study also reveals that NARICT and IAR had not been able to enhancing high quality chemical, leather, and agriculture industry. This finding collaborates the findings of Bell and Pavitt (1992) who observe that developing economies are not competitive in the global market because they do not posses distinct resources such as technological skills, knowledge, experience and institutional structures and linkages that would facilitate growth and development of science and technology.

The findings of the study also reveal that NARICT and IAR had not been able to enhance performances within the framework of the National Policy for Science and Technology. This has really shown on the budgets of both organizations. Over the years, the budget of the Federal government to NARICT and IAR had been inadequate. These alone, can the hamper performances of the organizations.

Also from the findings of this study, we have observed that policies have failed in directing and monitoring the implementation of science and technology policy in Nigeria and we could attest to this at every stage of the policy management process such as:

i. The inability to identify and articulate the problem.

ii. The inability to specify objectives and targets.

iii. Poor design of strategies and policy instruments.

iv. The implementation.

v. Evaluation and

vi. Feed back.

As a result of these facilities at these stages of policy management process, science and technology have suffered setback and retrogression and we can ascribe the failures to:

i. Poor policy formulation.

ii. Inadequate financial resources.

iii. Overlapping of responsibilities among the research institutes.

iv. Weak political will. e.g. inadequate funding from government

v. Institutional weakness. e.g. shortage of qualified staff and inadequate equipment and other facilities.

vi. Unreliable and inadequate data.

**Findings on Monitoring and Evaluation of NARICT and IAR**

The finding of this research indicates that the monitoring of these institutes is not regular and when monitoring even occurs, there seems to be a weak mechanism to check and ensure productivity. The supervisory ministry from the headquarter shows some level of non-challant attitude to the monitoring of research, thereby leaving relevant areas concerned to research. Research and performance are better carried out when there is adequate monitoring of the activities of the institutes. Because there is poor attitude to the monitoring of research, evaluating the result becomes a problem. In some cases, it is even difficult for the institute to give an annual evaluation of work and other researches that have been carried out within the year. These also create the problem of planning in terms of achieving the aims and objectives of the institutes. Policies would be difficult to implement since there is no feed-back from evaluation as a result of poor monitoring.

In summary, the issue discussed above is that poor monitoring both within and from the Federal Ministry of Science and Technology is a major problem affecting the productivity of these institutes.

# CHAPTER SIX

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 6.0 Introduction

This chapter focuses on the summary of the work and presents the conclusions emanating from the analysis of the data for the study. It is divided into two broad sections: summary and findings. It also contains the list of recommendations in order to enhance the attainments of the objectives of the National Policy on Science and Technology, by NARICT and IAR.

## 6.1 Summary of Findings

This study sets out to evaluate the adequacy of the national policy on science and technology in Nigeria, taking NARICT and IAR, Zaria as case studies. This study chose these two organizations because both are research institutes. Another reason is that the objectives of these organizations were to provide raw materials for Nigeria's local industries so as to make commodities available for Nigerians and create employment opportunities to generate income, create wealth and import substitution for the welfare of Nigerian.

The study found that government allocation to research institutes was poor thereby, affecting the performance of the institutes. This is because governmental allocation mechanism is a failure and such failure is a result of poor management process of government resources. This is attributed to the problem of specification of targets and objectives and the inability to identify and articulate the problems. For example, in the case of IAR, as a case study, while most of the existing research institutes in the country have fewer mandates, mostly for four to six crops, the institute has nine crops. Furthermore, the Institute has three research out-stations at

Minjibir and Kadawa in Kano State, Talata Mafara in Zamfara State, and the headquarters in Samaru, Zaria and at the three outstations. The institute manages about 35ha of farm land being cultivated for both rain-fed and irrigation researches all year round. Also, the institute has a fleet of about 23 Tractors, about 800 staff of various cadres and about 7 research analytical laboratories, all committed to research. The maintenance of these assets as well as the institute's machines and equipment and putting them in proper use for research require huge fund outlay.

Despite being one of the biggest, oldest and most prolific in terms of technology development, the institute paradoxically is one of the least funded research institutes. More so, the inadequate funding is further declining every year. For example, while the institute's appropriated capital fund was ₦61250,257.00 million in 2005, it dropped to ₦21000,000.00 million in 2007.

The institute is aware of the national challenges in food security, Vision 20:20:20 and the Millennium Development Goals (MDGs) as well as the Federal Government policies on same, and is poised to take up the challenges. However, in the last two years, budgetary ceilings particularly in respect of capital and overhead allocations had always been fixed arbitrarily often by people who know next to nothing about IAR operations and targets.

Secondly, the study shows that the performance of the research institutes does not depend on the implementation of the science and technology policy. It shows that no relationship exists, and the implementation of the science and technology policy does not influence the performance of the research institutes. The implication is that even when the research institutes make available recommendations regarding some research outcomes to the government to implement, it becomes a problem. It implies that there is no correlation between implementation of policy and actual performance.

Moreover, even the strategies adopted by the research institutes to encourage inventions and innovations are inadequate. This is as a result of failed implementation of science and technology policies which is attributed to poor design of strategies and policy instruments, as well as the inability to evaluate and get feedback.

Finally, the findings revealed that there is no relationship between the performance of the research institutes and the autonomy granted to them by government. In other words, the performance of the research institutions is not a function of the autonomy granted to them.

## 6.2 Conclusion

The results of these findings using Chi-square analytical tool shows that the policy of science and technology has not succeeded in the provision of local raw materials and goods at an affordable rate in NARICT and IAR.

The results also revealed that NARICT and IAR have not contributed in providing high quality chemical, leather and agricultural products. It also showed that NARICT and IAR have not proffered solutions in enhancing performance within the framework of the National Policy on Science and Technology. This is because whether the government is committed or not, if it does not put in place measures to encourage or improve the efficiency and effectiveness of the research institutes, it will have no multiplier effect on the performance of the research institutes. The measures could be in the form of incentives so as to encourage productivity. Development today is determined by the ability to establish a synergistic interaction between technological innovation and human value, leading to a new set of organizations and institutions that create positive feedback, loops between productivity, flexibility, solidarity, safety, participation and accountability in a new model of development that

could be socially and environmentally sustainable.

Secondly, the study reveals that there is no significant relationship between the implementation of the science policy and actual performance by the institutions. The implementation of science policy does not influence the performance of the research institutions. The implication is that even when the research institutions make available recommendations, the government does not implement them. This shows that there is no synergy between policy implementation and actual performance. According to Akpan (2003), it is easy to agree on the goals, but difficult to develop those that could be socially and environmentally sustainable. The developed world for a long time had learnt and made enduring, continual and sustainable policies that naturally have helped them break-through the course of history unfortunately, that has not been the case with developing nations.

Finally, the result of the study reveals that there is no significant relationship between the autonomy granted to the research institutes and the actual performance by the institutes. Hence, the performance of the research institutions is not a function of the autonomy granted to them. In other words, it shows that it is not necessary to grant the research institutions absolute autonomy for them to perform.

## 6.3 Recommendations

In order to enhance research and development in Nigeria, this study recommends the following,

1. There should be enhancement of incentives or other motivational measures such as research grants and allowances so as to encourage researchers to embark on serious research work in order to facilitate the process of growth in the Nigerian economy. Research is only effective if researchers are well

motivated to carry out their research work.

2. Funds meant for research and procurement should not be lumped together, in order not to misplace priorities. That is, funds meant for research work should be set aside and should be strictly used for the assigned purpose (research activities)
3. Government should be more committed to the implementation of the science and technology policy so as to enhance the performance of workers in the research institutions. This is because science and technology are the bedrock for any meaningful development or progress. No country can develop in the absence of science and technology.
4. There should be improvement in the monitoring of the research institutes by government to ensure adequate performance of the staff in the research institutes. It is only with improved monitoring that the performance of the institutes will lead to the overall progress of Nigeria.
5. Government should increase funding in order to promote research in the research institutes. Research anywhere in the world is very expensive. Therefore, there is a need to increase the funds allocated to the research institutes.
6. Finally, there is the need to establish government targets for productivity in science and technology in the research institutes by giving reward to deserving research institutes, while imposing penalties on those research institutes which fail to meet their established targets. This will go a long way to improve the productivity of the research institutes in Nigeria.

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**APPENDIX I**

D.B. Ewesuedo,
Department of Public Administration,
Faculty of Administration,
Ahmadu Bello University,
Zaria.

Dated:……...

**LETTER OF SELF INTRODUCTION**

Dear Respondents.

I am a student of the Department of Public Administration, Faculty of Administration, Ahmadu Bello University, Zaria. I am conducting a research on "An evaluation of national policy on Science and Technology in Nigeria a case study of National Research Institute for Chemical Technology (NARICT) Zaria and Institute of Agricultural Resources (IAR) Zaria"

Your sincere responses to the questions below shall be highly appreciated and treated confidentially you not required to write down your name in order to protect your right of anonymity. Please tick this way [√ ] in the spaces provided in the questionnaire or make comments wherever required in the questions.

Thank you

Yours sincerely

D.B Ewesuedo

The Researcher

QUESTIONAIRE FOR STAFF OF NATIONAL RESEARCH INSTITUTE FOR CHEMICAL TECHNOLOGY (NARICT), FEDERAL MINISTRY OF SCIENCE AND TECHNOLOGY (FMST), FEDERAL MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (FMARD) AND INSTITUTE OF AGRICULTURAL RESOURCES (IAR)

SECTION A

BIO-DATA

1. Your organization …….

a. NARICT [ ] b. FMST [ ] c. FMWR [ ] d. IAR [ ]

e. None of the above [ ]

2. Sex: Male [ ] Female [ ]

3. How old are you? a. 18-25yrs [ ] b. 26-35yrs [ ] c. 36-45yrs [ ]

d. 46yrs-55 years[ ] e. 56-above years [ ]

4. Marital status: a. Single [ ] b. Married [ ] c. Devoice [ ]

5. Educational Qualification: a. SSCE/GCE [ ] b. OND/NCE [ ]

c. HND/Degree [ ] d. Others [ ]

6. Rank: a. Junior staff [ ] b. senior staff [ ]

7. Years of service: a. 1yr [ ] b. 2-5yrs [ ] c. 6-15yrs [ ]d. 16-35yrs [ ]

**SECTION B**

National Research Institute for Chemical Technology (NARICT), Federal Ministry of Science and Technology (FMST), Federal Ministry of Agriculture and rural Development (FMARD), and Institute of Agricultural Resources (IAR) performance and government commitment in developing the country in the area of science and technology

Please tick in the boxes provided below and above.

Key

SA = Strongly Agree

A = Agree

UD = Undecided

DA = Disagree

SD = Strongly Disagree

| S/No. | | SA | A | UD | DA | SD |
|---|---|---|---|---|---|---|
| 8 | Function of NARICT, and IAR is sufficient. | | | | | |
| 9 | The level of Government commitment in achieving the function of NARICT, and IAR is sufficient. | | | | | |
| 10 | NARICT, and IAR have achieved their function in the science and technological development in Nigeria. | | | | | |
| 11 | Government allocation to NARICT, and IAR is adequate to perform their functions. | | | | | |
| 12 | Staff of NARICT, and IAR are well trained locally and abroad by Government. | | | | | |
| 13 | Performance of NARICT, and IAR is affected by absence of Government commitment. | | | | | |
| 14 | The level of Technological transfer is relatively low | | | | | |
| 15 | Government investing more on Institutions will enable them to perform better. | | | | | |

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| 16 | The poor performance of research institute in the country is a function of unqualified research officers. | | | | | |
| 17 | Government is insensitive to the activities of research institutions in the country. | | | | | |

SECTION C

Science and Technology Policy Implementation

| S/No. | | SA | A | UD | DA | SD |
|---|---|---|---|---|---|---|
| 18 | The level of achievement of NARICT, and IAR's mandate is very high. | | | | | |
| 19 | The strategies adopted by NARICT, and IAR to encourage inventions and innovations are sufficient. | | | | | |
| 20 | Government has encouraged Technological fabrication in Nigeria through NARICT, and IAR. | | | | | |
| 21 | There is a high level of scientific technological development in Nigeria through NARICT, and IAR. | | | | | |
| 22 | The effect of NARICT & IAR activities on the overall economy is very high. | | | | | |
| 23 | NARICT, and IAR have problems militating against the achievement of their mandate. | | | | | |
| 24 | The current performance of research institute is being influenced by the implementation of science and agricultural policy. | | | | | |

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|---|---|---|---|---|---|---|
| 25 | Considering the current reform in other sectors of our economy, we need some reform in research institution to ensure better performance. | | | | | |
| 26 | In terms of facilities and equipment, the research institute can be rated high. | | | | | |

SECTION D

Level of autonomy given to NARICT, FMST, FMWR and IAR

| S/No. | | SA | A | UD | DA | SD |
|---|---|---|---|---|---|---|
| 27 | The level of autonomy granted to NARICT, and IAR is adequate. | | | | | |
| 28 | NARICT, and IAR have been able to carry out their functions because of the autonomy given to them. | | | | | |
| 29 | NARICT, and IAR are completely autonomous. | | | | | |
| 30 | The achievements of NARICT, and IAR are as a result of autonomy granted to them. | | | | | |
| 31 | Lack of monitoring of NARICT and I.A.R. affect the implementation of science and technology policy adequate to get feedback on their performance. | | | | | |
| 32 | The organizational structure of NARICT, and IAR is not adequately designed to carry out their mandate. | | | | | |
| 33 | The best way to improve the performance of NARICT, and IAR is granting them complete autonomy. | | | | | |

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| 34 | Absolute autonomy granted to research institute in the country will threaten the security of the country. | | | | | |
| 35 | Privatization of research institutes in the country will be a better solution for improve performance. | | | | | |
| 36 | The Ministry of science and technology monitors research institutes performance in line with their mandate to ascertain their effectiveness. | | | | | |