BIBLIOMETRIC ANALYSIS OF AUTHORSHIP PATTERNS OF RESEARCH OUTPUT IN AGRICULTURE AND VETERINARY COMPLEX OF AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA, FROM 2002 - 2012

Matthias Gabriel KASA
MLS/EDUC/3102/11-12

A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL AHMADU BELLO UNIVERSITY, ZARIAIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF LIBRARY SCIENCE (MLS) DEGREE

**DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE,
FACULTY OF EDUCATION,
AHMADU BELLO UNIVERSITY, ZARIA**

MAY, 2015

DECLARATION

I hereby declare that this dissertation entitled the "BIBLIOMETRIC ANALYSIS OF AUTHORSHIP PATTERNS OF RESEARCH OUTPUT IN AGRICULTURE AND VETERINARY COMPLEX OF AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA, FROM 2002 - 2012" is a record of my own research work under the supervision of Prof.U. Ibrahim and Dr. K.A. Momoh. It was never presented anywhere, either wholly or in part, for the purpose of the award of a degree. All literatures consulted and cited were fully acknowledged within the text and by means of references.

Matthias Gabriel KASA …… …….

Signature Date

CERTIFICATION

This dissertation entitled "BIBLIOMETRIC ANALYSIS OF AUTHORSHIP PATTERNS OF RESEARCH OUTPUT IN AGRICULTURE AND VETERINARY COMPLEX OF AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA, FROM 2002 - 2012" by Matthias Gabriel Kasa meets the regulation governing the award of the Master of Library Science (MLS) degree of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

Professor U. Ibrahim
Chairman, Supervisory Committee

Date: 24/6/15

Dr. K.A. Momoh
Member, Supervisory Committee

Date: 25/5/15

Dr. Abdullahi Musa
Head, Department of Library
And Information Science

Date: 1/9/15

Professor A.Z. Hassan
Dean, Postgraduate School

Date: ……...

DEDICATION

This work is dedicated to the evergreen memory of:

Mrs. Amina Theresa Gabriel Kasa

Mr. Kamai Gabriel Kasa

To my

"*Baby girl*" – Afiniki, a dear and understanding wife, and to our children, Asangaliug, Amina, Kutiye and Land Lord Tisan.

And to the unconditional contributions of

"*First Lady and mother*" – Gloria, to my siblings Kukat, Esther, Jummai, and First Land Lord, Bamba

ACKNOWLEDGEMENT

Glory and honour be to the blessed Trinity for guarding me and the support into every task at every time of dire need.

I am very thankful to Professor U. Ibrahim, the Chairman of my supervisory committee and to Dr. K.A. Momoh, member of the committee for their persistency, concerns and encouragements.

I am grateful to the Head of Department of Library and Information Science and all the staff for the numerous roles and contributions made without which the success and completion of the course work as well as the thesis wouldn't be.

Professor Balarabe Tanimu former director of IAR and now of blessed memory and Professor Shehu G. Ado and staff of Agricultural Library are sincerely acknowledged for relentlessly supporting the cause for further studies. I also wish to document the support of Professor Saidu Makarfi the former Chairman of Agriculture and Veterinary Complex and the faculty staff of the complex who made the study hitch free.

The journey so far has been easier because of the prayers and moral support of Gloria (big sister and mum), Kukat (the evangelist), Esther (understanding one), Jummai (the calm one) and Bamba (a dear friend and brother). Not forgetting Mrs. Grace I. Nock, Professor D.A. Aba, Dr. (Mrs.) M.D. Katung, Suleiman A. Iro, Professor A. Falaki, Professor C. Whong, Professor E. Amans, Professor Ben Ahmed, Professor J. Olukosi, Dr. T. Fadiji, Dr. A.A. Yusuf, Professor Bamidele Lawal, Professor O. Banwo, Professor B.D. Kashina, Professor A.B. Zarafi, Dr. P. Tunku, Professor Sam Duru and the entire IAR family for supporting me till the completion of the thesis work.

I am indebted to my children Jotham, Jochebed, Joanna and Jason for bearing all my excesses. To my dear wife – Afiniki, I am eternally grateful because of her role on the path to fruitful life and accomplishments.

I want to acknowledge the following: Mrs. Habiba Gwari, Musa Ahmed, Mrs. A. Akuso, Aisha Jimada, Bikisu Mahadi, Rhoda Goshie, Rufa'I Aliyu, Alh. Tanimu Shika, Alh. Dogara Haruna Kudingi, Aliyu Abdulkadir, Mrs. M. Yusufu, Hajiya M. Dadari, Hajia Binta Haruna, Mrs. Aderonke Adedokun, Mrs. M. Ali, Binta Bello, Abigail Bako, Abdullahi Adamu, Sa'adiya Amata, Alh. Ado Yusuf, T.M. Tukur and Jummai Abdulmalik for their moral support.

To my classmate, friends, relatives, neighbours and numerous colleagues whose names are too numerous to mention, I sincerely thank you all and God bless.

ABSTRACT

The study is a bibliometric analysis of authorship patterns of research output in Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria, Nigeria from 2002 - 2012. From pools of models on research productivity, thestudy adoptedfrom two models those factors that facilitate quantitative analysis that comprise of number of publications, organizational structure, rules governing promotions, employees and colleagues relationship to research output in order to provide answers to four research questions raised and to test the conformity of Lotka's Law of research productivity. The population constituted faculty members from the six units that administratively made up the Agriculture and Veterinary complex of Ahmadu Bello University, Zaria, these units comprise of Institute for Agricultural Research (IAR), Division of Agricultural Colleges (DAC), National Animal Production and Research Institute (NAPRI), Faculty of Agriculture (FOA), National Agricultural Extension and Research Liaison Services (NAERLS) and The Faculty of Veterinary Medicine and Teaching Hospital (FVM&TH). Bibliometric methods utilized quantify publication counts, nature of research output, authorship patterns and nature of collaboration of the sampled subjects. Data collected were stratified and randomly sample to proportionately perform this task. During the period of the study (2002 – 2012) a total of 1137 publications were published by the faculty members, the most published research output format were journals and IAR was the most productive unit. The yearlydistributions and spread of research output show that the year 2006 had the highest number of cumulative publications. Four authors per paper dominated authorship pattern and collaboration was generally internal (among members of the same unit).Test of hypothesis using Chi-square revealed no conformity with Lotka's Law of Productivity, but the collaborative coefficient was significant and highly positive with 0.8417.The study conclude that bibliometric analysis of the faculty members research output has provideuseful information map showing authorship patterns, trends of resource growth, nature of collaborations and contributions to agricultural information knowledge base by individuals as well as the units they represent. The recommendations made were in line with the findings is equal grading and diversification of research output format from journals to attract patronage, so as to target the desired audience and simplify information courier. The composition and arrangement of the research output in the complex should be maintained because it facilitates extraction and quantification of faculty members research output. Periodic assessment should be tied to a reward system that acknowledges contributions made by individuals and units of the complex to boost the number of papers publish, participation in research activities, documentation and sharing of experiences.Authorship patterns presently dominating in the complex is multiple which is characteristics of scientist in the applied sciences, however, the patterns must be maintained and encouraged to reflect intra- and cross-discipline.

TABLE OF CONTENTS

Content **Page**

Title page i

Declaration ii

Certification iii

Dedication iv

Acknowledgement v

Abstract vi

Table of Content vii

List of Tables xiii

List of Figures xxvii

List of Appendices xxviii

CHAPTER ONE: INTRODUCTION 1

1.1 Background to the Study 1

1.1.1 Concept, application and principles of bibliometrics 3

1.1.2 Background information on Ahmadu Bello University Agriculture and Veterinary Complex 5

1.1.3 Research activities of faculty members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria 11

1.2 Statement of the Problem 13

1.3 Research Questions 14

1.4 Objectives of the Study 15

1.5 Hypothesis 15

1.6 Significance of the Study 15

1.7 Scope and Limitation of the Study 16

1.8 Operational definition of terms 16

REFERENCES 18

CHAPTER TWO: REVIEW OF RELATED LITERATURES 20

2.1 Introduction 20

2.2 Conceptual Models for Research Productivity 20

2.2.1 Adopted Models 23

2.3 Research Output Formats 24

2.4 Quantitative Analysis of Research Outputs 27

2.5 Nature of Collaboration in Scientific Research Output 29

2.6. Research Output in Agriculture and Related Fields 32

2.7 Application of Lotka's Law of Scientific Productivity on Authorship Patterns 34

2.8 Summary of the Review of Related Literatures 36

REFERENCES 38

CHAPTER THREE: RESEARCH METHODOLOGY 43

3.1 Introduction 43

3.2 Research Method Adopted for the Study 43

3.3 Population of the Study 44

3.4 Sample and Sampling Technique 45

3.5 Instrument for Data Collection 47

3.6 Data Collection Procedure 48

3.7 Statistical Technique for Data Analysis 48

REFERENCE 50

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION 51

4.1 Introduction 51

4.2 Response Rate 51

4.3 Data Analysis 52

4.3.1 Research Output Formats of Members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 – 2012 52

4.3.2 Authorship Patterns of Faculty Members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria Research Output from 2002 to 2012 54

4.3.3 Nature of Collaboration Among Faculty Members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria from 2002 to 2012 57

4.3.4 Research Output Spread Among the Six Units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 to 2012 61

4.4 Test of Hypothesis 63

REFERENCES 65

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS 67

5.1 Introduction 67

5.2 Summary of the Study 67

5.3 Summary of Major Findings 68

5.4 Conclusion 69

5.5 Recommendations 69

5.6 Suggestion for Further Study 70

BIBLIOGRAPHY 71

APPENDICES 79

LIST OF TABLES

Table **Page**

3.1: The distribution of faculty members in the Agriculture and Veterinary Complex, ABU., Zaria 43

4.1: Response rate distribution 51

4.2: Frequency distribution and percentage scores of research output formats of faculty members in the Agriculture and Veterinary complex from 2002- 2012 53

4.3: Authorship patterns 66

4.4: Nature of collaboration 58

4.5: Distribution and percentage score of the research output of the units of the Agriculture and Veterinary complex of Ahmadu Bello University, Zaria from 2002 – 2012. 61

4.6: Chi-square test of observed and expected distribution of authors research output patterns 63

LIST OF FIGURES

Figure **Page**

1: Distribution of research output formats by faculty members in the Agric. and Vet. complex from 2002 – 2012 53

2: Graphical presentation of authorship patterns of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria (2002 – 2012) 55

3: Distribution of the different types of collaboration existing among faculty member 58

4: Frequency counts of faculty members research output per unit in Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria (2002 – 2012) 62

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Research outcome by individuals and institutions are worth evaluatingto assess performance and for posterity. To do so effectively and efficiently, evaluation must be done using a veritable tool that is sufficient to record, communicate results and undisputedly used for decision making. According to Pendlebury (2009), quantitative analysis is perhaps the popular tool used for scientific evaluation studies and reporting; it supports counting, comparing quantities and analyzing measurements. He reported bibliometrics analysis as one of the quantitative indicators that are widely and increasingly used for scholarship evaluation purposes.

The aim of bibliometric analysis is to reveal the extent of research output, activities, preferences and nature of produced literature. Okafor (2011) opined that research is paramount to all human activities, especially its intellectual application in the investigation of matter that will aid discovery and developing methods and systems for the advancement of humans, animals, society and the economy.

Agricultural research plays a significant role in the livelihood of man, animal and a measure of a country's economic strength and aspirations. Agriculture is, and have remained very important because it provides food, employment, raw materials for industries, income to farmers, a medium of foreign exchange, shelter, market for industrial

goods and aiding rural development. The practice is aimed at producing high yielding crops, better and improved animal breeds, provide suitable storage facilities, pests and diseases control, and using formal or informal education and practical methodologies to achieve these goals that have been documented. According to Olufalaji (2009), agriculture in Nigeria employs 75% of its population directly as farmers or indirectly as processors, marketers or agro-allied industrialist making it very strategic.

Agricultural activitiesin Nigeria are supported by established National Agricultural Research Systems (NARS). The most recognized NARS are the National Agricultural Research Institutes (NARIs), Faculties of Agriculture and Veterinary Medicines whose mandates are to undertake novel researches on crops and animals spanning across the different and unique ecological zones of the country. According to Bukar, Adamu and Bakshi (1997) there are about 18 National Agricultural Research Institutes (NARIs) in Nigeria. In addition, there are about twenty three (23) agriculture and veterinary faculties to strengthen agricultural research and development.

Abalu (2001) argued that agricultural institutions in Nigeria with mandate to research are not only essential for increased agricultural productivity, they are also important for the overall processes of agricultural and economic development. He affirmed that properly functioning agricultural institutions effectively integrate, transfer research-induced technology to farmers and measure agricultural research benefits to society. In an attempt to ensure improvement on agricultural output, the three tiers of government in Nigeria, i.e. federal, states and local government councils set up ministries, departments

and specialize programmes to ensure the smooth operations of agricultural activities as well as products of agriculture.

The National Agricultural Research Systems (NARS) today mitigates all earlier arrays of agricultural schemes and policies in Nigeria that generally tended to support only increased production of commodities in the country. Prominent ones include Farm Settlement Schemes (FSS) in the early 1950s for creating farmsteads, increase commodity output and employment for young school leavers, River Basin Development Authorities (RBDAs) for the purpose of harnessing water resources for farmers throughout the country, Green Revolution Scheme (GRS) that encouraged all Nigerians in both urban and rural areas to go into agriculture for both commerce and provision of food for home consumption and Agricultural Development Programs (ADPs) in all states of the federation to help organize farmers into more productive agriculture through the provision of modern inputs.

1.1.1 Concept, application and principles of bibliometrics

Bibliometrics is a branch of information science that study productivity of information resources using quantitative and qualitative methods. The term “Bibliometrics” was coined by Alan Pritchard in 1969 and defined it as "the application of mathematics and statistical methods to books and other media of communication" (Sun, Wung and Ho, 2012). Researchers apply bibliometric methods to measure texts, patterns of publication within a given body of literature, determine author productivity, and describe

author(s) collaboration. Remarkably, bibliometrics has been able to determine obsoleteness of resources, epistemology of knowledge and use of citation analysis.

Bibliometrics has been applied to reveal trends and research performance, impact factor, immediacy index, data reduction methods, discrimination value, relevance criteria, etc. It remained the best method for citation analysis (direct citation, co-citation analysis, bibliographic coupling, author co-citation analysis), and empirically to verify bibliometric laws (Bradford's law of scatter, Lotka's law of scientific productivity, and Zipf's law of word occurrence – most popular laws). For instance, Bradford's law finds out core academic journals of a subject (Gu, 2004) and for exploring the scientific productivity, Lotka's law revealed frequency distribution of scientific productivity. Zipf's law established the frequency of words within a text (Wang, Pang and Huang, 2012). These laws have also been conceptualized to facilitate studies of academic disciplines and information phenomena in a multitude of ways to achieve multidimensional researches that include comparative studies of publications, analyzing the growth of the literature of a field and discovering clusters of related publications (van Raan, 2001; Weiss, 2007).

Bibliometric principles have become the metric of social, economic and academic relevance. It is universally acceptable metric method for university ranking, its results enhances the accessibility and visibility of publications in both content and context and reveals the interoperationability and relationships of research collaborations. Prominently, therefore, bibliometric plays a great and vital role in the processes and products of communication activities.

1.1.2 Background information on Ahmadu Bello University Agriculture and Veterinary Complex

Ahmadu Bello University has one of the largest agricultural programmes in Nigeria. The programmes have been grouped and situated in six different departments, units and divisions. The six combined are referred to as the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria, three of them assuming the status of institutions, one college and two faculties. These six are: Institute for Agricultural Research (IAR), Division of Agricultural Colleges (DAC), National Animal Production and Research Institute (NAPRI), Faculty of Agriculture (FOA), National Agricultural Extension and Research Liaison Services (NAERLS) and The Faculty of Veterinary Medicine and Teaching Hospital (FVM&TH). The six institutions were brought together as complex by the management of Ahmadu Bello University, Zaria because of their very close integration, opportunities and the believe that their partnership will lower the high cost of investments in agriculture, influence policies to bring forth better technological breakthrough and bringing together key players along the value chain (researchers, extension agents, farmers, students, policy makers or the private sector).

Although each member of the complex has its own mandate, but their collective mandate includes mediating within the regional structures in cooperation with Ministries of Agriculture and Natural Resources, and agricultural stations within and outside the country. The establishment of the complex was also to facilitate the training of scientists, academics, agricultural and veterinary officers while at the same time undertaking and implementing research programmes under close supervision and collaboration with

universities, Ministries of Agriculture and Natural Resources as well as private, national and international agencies.

The complex objectives to farmers remain to educate, sensitize and update them on improve innovations and technologies capable of increasing their income, welfare and productivity levels through reduction of yield loss and realizing the national objective of self-reliance and sufficiency in food and raw materials. Describing the complex characteristic, Ibrahim (1997/98) reported that the researchers participate in teaching, research and supervision in the Faculties of Agriculture, Veterinary Medicine and the College of Agriculture as well as disseminating information to stakeholders. In addition to the complex uniqueness, it is also recognized worldwide for offering specialized programmes/services leading to the award of certificates, diplomas and degrees in agriculture and veterinary sciences by the two faculties and a college. The complex staff comprised those of the agricultural research institutes (institute based), colleges, Faculties of Agriculture and Veterinary Sciences (university-based) who are fully involved in teaching, research and community service. Although funded separately, the six entities function in very close association with each other and share the teaching, supervision, research, extension and community service responsibilities, which led to efficient use of resources and avoidance of unnecessary staff duplication.

The IAR was established in 1922 as the headquarters of the defunct Department of Agriculture of the Northern Provinces, which was transferred to Ahmadu Bello University in 1962. IAR in cooperation with the Ministry of Agriculture and Natural Resources of

each state and other agricultural research centres is mandated to undertake research activities on the genetic improvement of sorghum, groundnut, cowpea, cotton, sunflower, castor and Artemisia. The institute also addresses the problems of the aforementioned crops and in particular problems of their agronomy, adaptation of improved varieties, development and testing of pest and disease control measures, farming systems into production systems, socio-economic problems of agricultural production, soil fertility and soil stabilization in the broad ecological zone covered by Jigawa, Kaduna, Kano, Katsina, Kebbi and Zamafara States (IAR, 1996; Ado, 2006).

IAR is structured into 9 programmes that comprised Artemesia Research, Product Development, Cotton, Agricultural Mechanization, Legumes and Oil Seeds, Cereals Research, Farming Systems, Biotechnology and Irrigation Research Programmes. According to IAR (2012), a total of 70 research staff are employed by the institute and ranked from Graduate Assistant to the position of Research Professor.

The Division of Agricultural Colleges is an amalgamation of Maigana farm training centre, the Livestock Services Training Centre, Mando Road, Kaduna and the Horticulture School at Kabba. These three centres were in 1968 transferred to Ahmadu Bello University, Zaria by the Interim Common Services (ICSA) and thereafter governed as a Division by two major policy making bodies; Board of Governors and the Professional and Academic Board. The Board of Governors formulate the overall policy guidelines for the Division while the Professional and Academic Board with the Director serving as its chairman directs the Professional and Academic work of the Division. The

Deputy Director assists the Director and looks after the academic functions of the Division's three colleges. The administration at each of the three Colleges is headed by a Provost who reports to the Director. Heads of Sections of major academic programmes and service units also assist the Provost in the administrative and academic functions of the College. In addition, there are also non-academic staff who functions in various capacities for the effective running of the colleges. In 1977, the Division was gazetted as a national middle manpower training institute and incorporated under NUC as an inter-university centre while its Academic programmes are being regulated by National Board for Technical Education (NBTE) with three levels of training offered (Certificate, the National Diploma (ND) and Higher National Diploma (HND)) with an academic staff strength of 147 ranking from Graduate Assistant to Professor (Rabiu, 2012; ABU MIS, 2013a).

The Faculty of Agriculture (FOA) was established in October 1962 as one of the six pioneer faculties of Ahmadu Bello University, Zaria. FOA started with four Departments namely, Agricultural Economics and Rural Sociology, Animal Science, Plant Science and Soil Science. Three Departments were later created that include Crop Protection (1968); Agronomy (1970) and Agricultural Engineering (1975). However, in 1976 the Department of Agricultural Engineering was transferred to the Faculty of Engineering. The faculty currently has six departments with academic staff strength of 127 who comprised of Graduate Assistant to Professors (Anonymous, 1987; ABU MIS, 2013b).

Faculty of Veterinary Medicine was established in 1964 to train Veterinary Doctors with the sound knowledge of modern veterinary medicine and capable of teaching, treating and preventing livestock pests and diseases, ascertaining unfit livestock for human consumption with special impacts on the local tropical environmental conditions. The faculty started with four departments namely Anatomy, Physiology, Pathology, and Medicine and Surgery and by 2012 added five (5) new ones bringing the total number of departments to nine (9), which are: Theriogenology and Production, Veterinary Anatomy, Veterinary Medicine, Veterinary Pathology and Microbiology, Veterinary Physiology and Pharmacology, Veterinary Public Health and Preventive Medicine, Veterinary Surgery and Veterinary Teaching Hospital. The establishment of a veterinary teaching hospital to provide teaching in clinics and also service to the surrounding community was actualized in 1986. The Faculty of Veterinary Medicine and Teaching Hospital has academic staff strength of 121 that include Graduate Assistantship to Professorship (Anonymous, 1987, ABU MIS, 2013c).

National Agricultural Extension and Research Liaison Services (NAERLS) was established in 1975 as a separate organization within the Agricultural complex of Ahmadu Bello University to develop, collate, evaluate, disseminate agricultural technologies and conduct research in agricultural extension methodologies and policy; and provide leadership in capacity building of stakeholders to meet the present and future agricultural developmental challenges of the country. The NAERLS is structured into 6 programmes; Agricultural Engineering and Irrigation, Agricultural Extension and Economic,

Agricultural Media, Crop and Forestry, Food Technology and Home Economics and Livestock and Fisheries Programmes.

However, to effectively discharge its functions of coordinating the overall planning and development of extension liaison activities throughout the country, NAERLS established 5 zonal offices located in each of the five (5) coordinating research institutes that comprise National Root Crop Research Institute, Umudike; Institute of Agricultural Research and Training, Ibadan; National Cereals Research Institute, Badeggi; Lake Chad Research Institute, Maiduguri, and Institute for Agricultural Research, Zaria. divided into extension, monitoring and evaluation. The centre has a total of 42 research/academic staff (Ekoja, 2003, NAERLS, 2011).

National Animal Production Research Institute (NAPRI) was established in 1927 and called the Shika Ranch as a research station under the Department of Agriculture of the then Northern Province. In 1954, the station became the research base of animal and pasture of the Agriculture Research Division and continued as a Sub-station of IAR until 1975 when it became by Act of law, an autonomous research institute called NAPRI. NAPRI like other institutes consists of researchers from different professional disciplines all working in programmes to ensure that agriculture is developed and sustained. The institute's research staff offaculty status were 40 andserve in Small Ruminants, Beef, Poultry, Swine, Forage and Crop Residue, Animal Production, Livestock System and Animal Reproduction Research Programmes of the institute (ABU MIS, 2013d).

1.1.3 Research activities of faculty members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria

Research activities of faculty members in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria is to ensure survival of science and technology, support claim by inventors and to effectively disseminate findings that can enhance agricultural development through publication, replication of research on-station and on farmers' fields. To do this effectively, it has institutionalized its research activities and services to support the agricultural development efforts and agenda of the three tiers of governments' ministries, parastatals, departments and specialized programmes as well as facilitate education, replication of trials on farmers' fields and foster collaboration among and between specialists.

The complex also supports linkages among numerous agricultural stakeholders to bridge gaps that retard agricultural development through specialized activities that comprised farm walk, cropping schemes, editorials, documentaries, consultancy, farm shows, radio and television broadcasting. These research output media have also enhanced the dissemination of quality agricultural research activities and proffer ways of resolving agricultural challenges.

Research works undertaken by the different units of the complex are streamlined as either specialized programmes or departments from which also research outputs are generated. These research outputs are varietal/animal breeds releases, soil, plants and animal management systems, appropriate technologies fabrications, maintenance and use, manure and fertilization application regimes, production, processing, handling, nutrition,

pests and diseases control/eradication, diffusion of technologies, articulating and the prioritizing agricultural sustainability and progress.

The efforts of individual or groups include verification and standardization of agricultural processes, products and practices, systematically to attain safety, environmental friendly while at the same time documented in order to add to the body of knowledge and improvement of man's living standard. The imperative of these research output for posterity have necessitated sharing with learned society, deposition into institutional repositories and publishing in journals, books, pamphlets, technical and annual research reports. These accomplishments have also attracted other research institutes, companies and philanthropist to engage the membership units either individually or as groups to undertake and offer consultancy services, who on disengagement document the outcome of the research work. This consistency, the complex activities, the separate and existing autonomy of its components do not deter it from working in very close association with each other. For instance, academic staff takes up research projects, while research staff are also involved in teaching and supervision of students. Furthermore, the complex activities are stream lined to justify huge investments made by governments and the international community's on agriculture. This corroborates with the work of Ibrahim (1997/98) affirming that governments spend large sums of money in the funding of universities and research institutes to ensure smooth growth and development of agriculture to be able to sustain its growing population and high demand for agricultural raw materials.

1.2 Statement of the Problem

Agriculture has been reported to be one enterprise in Nigeria that employed a greater majority of its rural population and remain their major source of livelihood. It is acclaimed to be an alternative to petrol which immediately after independent has been the country source of revenue. To ensure that agriculture is fallback to, so much time and resources were devoted to institutionalizing agriculture and veterinary studies, services and training. So far, little has been written about the research output of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria especially on their authorship patterns and extent of research output.

The complex is the largest in the country with the mandate to three specialized agricultural institutes, two faculties (Agriculture and Veterinary and Teaching Hospital) and a College of Agriculture. Because of these size and commitment by governments in the three tiers (federal, state and local councils), a lot of research activities that serve as building blocks for agricultural development with the involvement of the complex have been generated and documented. This makes it imperative to investigate the complex research output and to bridge the gap that other literature have failed to address. Example, available works by Ibrahim (1997/98), Akobi (2007), Lakan (2007) and Okanlawon (2010) made efforts to disperse information on research activities and resources available for staff use making it difficult to evaluate author performance. These gross inadequacies hampered making generalizationof the complex major actors – faculty members. These works by Ibrahim (1997/98) focused on quantitative analysis of current scientific research and

productivity of IAR and NAPRI, Akobi (2006) studied the importance of the essential electronic agricultural library to researchers of Faculty of Agriculture. Lakan (2007) aimed at the availability and utilization of electronic information databases for staff of the complex, Okanlawon (2010) looked at the citation of core agricultural journals.

The need to actualize a knowledge base of research activities by the complex faculty members (authors) becomes inevitable especially with the calls to address the decimal yields, challenges of effective and efficient communication and retrospection,avoiding unnecessary duplication of research activities and becoming responsive to documented plights of stakeholders.

1.3 Research Questions

The research questions for this study are as follows:

1) What are the research output formats of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 - 2012?
2) What is the authorship pattern of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 - 2012?
3) What is the nature of collaboration among the faculty members in research output in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 - 2012?
4) What is the research output spread among the six units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 - 2012?

1.4 Objectives of the Study

The study set out to achieve the following objectives:

1. To determine the research output formats of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 - 2012.
2. To find out the prominent authorship pattern of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 - 2012.
3. To determine the nature of collaboration among the faculty members in research output in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 - 2012.
4. To find out the research output spread among the six units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2012 – 2012.

1.5 Hypothesis

The hypothesis is stated below:

H_o: Research output of faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 – 2012 does not conform to Lotka's Law of Productivity.

1.6 Significance of the Study

The significance of this study is based on the fact that it will reveal useful information and the factors influencing faculty members research output in the complex. This is tied to the assertion that few scholars understudied the research output of faculty

members of the Agriculture and Veterinary Complex. The study will bridge the gap, aggregate the different parameters influencing individual, groups and units research output dispositions.

The study will reveal each unit performance, nature and preferences for research output; and be a reference material for consultation on the complex faculty staff performance during the period of investigation.

1.7 Scope and Limitation of the Study

The study covers only the faculty members of the six units that made up the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria. These categories of staff are those involved in teaching, supervision and research. The study is limited to eleven years period of research output (2002 – 2012) and considered only those who have attained the ranks of professors and associate professors in the complex.

1.8 Operational Definition of Terms

The conceptual meaning of the terms used are given as follows:

Agriculture: The practice of cultivation, farming, tillage and horticulture; production of plants and animals, processing of food, fibre, fuel and any other agricultural commodities that have an economic, aesthetic and cultural value.

Agriculture and Veterinary complex: This refers to the six agricultural specialize units brought together by the management of Ahmadu Bello University, Zaria for close integration, administration, opportunities and partnership to increase investment, influence

policies on agriculture and veterinary science, and better technological breakthrough while also bringing together key players to chant the growth, maintenance, sustenance and development of agriculture and veterinary sciences in the university.

Bibliometrics: A field of study that uses quantitative and qualitative analyses and statistics to look at patterns in academic publishing and scholarly communications transmitted via the medium of the World Wide Web.

Faculty members: These categories of staff are those involved in teaching, supervision and research in Ahmadu Bello University, Zaria.

Research output: Is a measure of publication output of faculty members.

Research: Is a planned inquiry into the nature of, reason for and consequences of any particular set of circumstances; whether these circumstances are experimentally controlled or recorded as they occur.

REFERENCES

Abalu, G.I. (2001). Policy Issues in Maize Research and Development in Sub-Saharan Africa in the Next Millennium. In: Badu-Apraku, B., Fakorede, M.A.B., Ouedraogo, M. and Carsky, R.J. (editors). Impact, Challenges and Prospects of maize research and development in West and Central Africa. *Proceedings of a Regional Maize Workshop* 4 – 7 May, 1999, pp.3-30, WECAMAN/IITA, Benin Republic.

ABU MIS (Ahmadu Bello University Management Information Services) (2013a). Staff List of Division of Agricultural Colleges. Available at http://www.abu.edu.ng/faculty/view_staff.php?depid=&fac=Division%20of%20Agricultural%20Colleges# (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013b). Faculty of Agriculture Staff List. Available at http://www.abu.edu.ng/category/cview.php?t=a&cid=2&cnm=Agriculture (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013c). Faculty of Veterinary Medicine and Teaching Hospital Staff Strength. Available at http://www.abu.edu.ng/category/cview.php?t=a&cid=13&cnm=Veterinary%20Medicine (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013d). National Animal Production Research Institute Staff list. Available at http://www.abu.edu.ng/unit/index.php?t=i&cid=20&cnm=Centres&did=135&dnm=NAPRI (accessed on 26th May, 2013).

Ado, S.G. (2006). Available Postgraduate Research Opportunities at the Institute for Agricultural Research, Samaru. ABU Postgraduate School Lecture Series. pp.2.

Anonymous (1987). A History of Ahmadu Bello University, Zaria 1962-1987. ABU Press Ltd., pp. 172-174.

Bukar, S., Adamu, A. and Bakshi, J.S (eds.) (1997). Nigeria, National Agricultural Strategy Plan: 1990-2010. Ibadan, African books Ltd., pp.71-116.

Ekoja, I.I. (2003). Farmers' Access to Agricultural Information in Nigeria. *Bulletin of the American Society for Information Science and Technology*, pp. 21 – 23, August/September.

FAO (Food and Agriculture Organization) (1997). Agriculture, food and nutrition for Africa: A resource book for teachers of agriculture. 412p. Rome.

Gu, Y. (2004). Information Management or Knowledge Management? An Informetric View of Scientometrics. *The Dynamics of Academia* 61: 285-299.

IAR (Institute for Agricultural Research) (1996). "This is the Institute for Agricultural Research (IAR)", Third Edition. Fadiji, T.O., Gefu, T.T. and Adeniji, O.B. (eds.). Publications and Information Unit, IAR, Samaru – Zaria.

IAR (Institute for Agricultural Research) (2012). Institute for Agricultural Research Staff and Phone Directory. A Publication of the Office of the Secretary, IAR, Samaru – Zaria.

Ibrahim, U. (1997/98). Quantitative Analysis of Current Scientific Research and Productivity in IAR and NAPRI, Zaria, Nigeria. *Library Focus* 15& 16: 36 – 42.

NAERLS (National Agricultural Extension and Research Liaison Services) (2011). NAERLS at a Glance. National Agricultural Extension and Research Liaison Services, Federal Ministry of Agriculture and Rural Development, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. NAERLS Printing press.

Okafor, V.N. (2011). Comparative Analysis of Research Output of Federal Universities in Southern Nigeria. *Library Philosophy and Practice* Available: http/libr.unl.edu/LPP/

Olufalaji, A. (2009). The Role of Research in Agricultural Development. Paper Presented at the Agriculture exhibition. Theme: Agriculture – The new frontier. Organized by Enhancing Financial Innovation and Access (RFInA) held at NIHORT, Ibadan. 29 – 30th March, 18p.

Pendlebury, D.A. (2009). *Whitepaper: Using Bibliometrics: A Guide to Evaluating Research Performance with Citation Data*. Philadelphia: Thomson Reuters.

Rabiu, S.A. (2012). Establishment of DAC's Academic Activities and its Roles in the Ahmadu Bello University and the Nation At Large. Paper presented in commemoration of ABU @ 50 Celebration held in NAERLS Conference Hall, 9p.

Sun, J., Wang, M.-H., & Ho, Y.-S. (2012). A Historical Review and Bibliometric Analysis of Research on Estuary Pollution. *Marine Pollution Bulletin*, 64(1):13–21.

Van Raan, A.F.J. (2001). Competition Among Scientist for Publication Status: Towards a Model of Scientific Publication and Citation Distribution. *Scientometrics* 51(1):347 - 357.

Wang, H-C., Pang, C-Y & Huang, J-Y. (2012). Analysis of Academic Research Performance from Publications in the Field of Computer Science. *Malayan Journal of Library & Information Science* 17(2): 51 – 70, August.

Weiss, A.P. (2007). Measuring the Impact of Medical Research: Moving from Outputs to Outcomes. *American Journal of Psychiatry* Feb;164(2): 206–14.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURES

2.1 Introduction

This chapter reviews literature that are related and relevant to the area of study. Focus is under the following sub-headings:

2.2 Conceptual Models for Research Output

2.3 Bibliographic Formats of Research Output

2.4 Quantitative Analysis of Research Outputs

2.5 Nature of Collaboration in Scientific Research Output

2.6 Research Output in Agriculture and Related Fields

2.7 Application of Lotka's Law of Productivity on Authorship Patterns

2.8 Summary of the Review

2.2 Conceptual Models for Research Productivity

Conceptual models show the set of relationships between factors that are believed to impact or lead to a target condition. According to Le Boeuf (2006), conceptual models define theoretical entitles, objects or conditions of a system and the relationship between them.

The choice of bibliometrics to identify research productivity is informed by its methodologies which recognizes and isolate specific variables contained within a definite

subjects for analysis. Therefore, the study shall select from the pools of variables those most appropriate for data collections, impact on research productivity and statistical verifications. Several models studied centred on the factors influencing research output of faculty members, most of them relied on factors beneficial in the promotion of faculty research productivity and their roles to community development. Some of the most popular models predicting research output and the extent of publications by faculty members reviewed by this study include:

a. **Bland Model:** This model, proposed by Bland *et al*. (2002) has three main components, which are individual characteristics, leadership characteristics and environmental (organizational) characteristics. The concern is how these three affects the productivity levels of faculty members.
b. **Finkelstein Model**: In this model seven variables are proposed to predict the extent of publications of faculty members, which include (1) interest of faculty members in research, (2) having highest education degree, (3) primary publishing habits, (4) previous publishing activities, (5) relationship with colleagues from the same discipline, (6) membership to several professional and academic journals, (7) devotion of adequate time to research (Finkelstein, 1984).
c. **Creswell Model:** The model tried to identify organizational factors influencing research output of faculty members. He described successful researchers as ones who promote their scientific status, devote at least one third of their time to research activities, publish papers in their specific field, receive positive feedback from their

colleagues and/or have a continuous and close relationship with their colleagues involved in similar research plans inside and outside of university. Thus Creswell model points to importance of organizational factors and also to research culture which influence individual productivity of faculty members (Creswell, 1985).

d. **Dundar and Lewis Model:** This model initially had two characteristics: (a) Individual characteristics associated with personal qualities and environmental experiences; (b) Organizational and department characteristics including variables associated with leadership, culture, structure and policy. Studying more than 3600 Ph.D research works in US, Dundar and Lewis (1998) found out that one of the most important factors for predicting research productivity of faculty members was faculty size.

e. **Teodorescu Model:** Proposes an international model for productivity. Teodorescu (2000) model states that individual success variables and organizational features are predictors of research productivity in national framework. He tested his model in 10 countries. Results from testing model show that correlates of productivity of faculty members are different at international level but those faculty members who continuously contribute in scientific seminars and/or are members of scientific societies associated with their specific field of study in most countries.

f. **Brocato Model:** Brocato (2001) pointed out various factors affecting research productivity of faculty members to include psychological factors, individual characteristics, environment and organizational, and group for conducting research. He found out that individual characteristics of faculty members such as motivation, professional networks and research training had high correlation with research

productivity. Furthermore, he reported that organizational, educational group (department) and disciplinary features had very least influence on research productivity compared to individual characteristics.

g. **Research Productivity Model:** A model by Ramirez and Nambbard (2004) centres on huge size of service sector in every country, in this, sector productivity of staff and particularly faculty members (knowledge workers) are also relevant. If an accurate system is established to measure productivity of knowledge workers (K.W), it can potentially be useful in monitoring and improving performance. Thus productivity of faculty members is also considered and discussed in the framework of productivity of K.Ws. Though some researchers addressed characteristics which are thought to be effective in the field of productivity, but up to now no research was able to address all aspects of a university and all items stated in research productivity promotion regulations in relation to their effects on productivity.

2.2.1 Adopted Models

Teodorescu (2000) and Bland *et al.* (2005) models were adopted for this study, their choice was based on the fact that their focus was on influence on the individual and organizations on research output. The factors they centred on influencing the individual research output comprise; (1) scientific status of faculty member (professor, associate professor, etc), (2) educational degree (master's, doctorate (PhD) and higher), (3) graduation university, (4) grade according to number of publications. The organizational factors include; (1) organizational structure of university (degree of centralization,

decentralization), (2) organizational culture, (3) rules and regulations for annual promotion of faculty members, (4) arrangement for providing faculty members with study opportunities by university, (5) Employees and colleagues attitudes.

Not all factors can be analysed quantitatively, therefore, to operate quantitatively, the following were the focus; number of publication, organizational structure, rules governing promotion of faculty members, employees and colleagues relationship to research output.

2.3 Research Output Formats

Wardikar and Gudadhe (2013) noted that publications constitute the most important form of communication in nearly all academic research, making scientific information publically available and allow the rest of the academic audience to evaluate the quality of the research. Through publishing findings, researchers gain recognition and become identified with scientific results. McBurney and Novak (2002) gave the most popular research output formats to include books, journals, conference papers, newsletters, magazines, bulletins, technical reports and monographs, and others they categorized under miscellaneous papers.

According to Ligthelm and Koekemoer (2009), writing and publishing of research constitute an integral part of academic life and extending the frontier of knowledge and the choice of research output format may be attributable to target audience and message to be

disseminated. For instance, newsletters which are normally four to eight pages, present notices of activities, recent publications, opportunities and upcoming events aimed at providing quick access to information resources. On the other hand, journal pages range from 30 pages and above, highlight innovative programmes and publications on critical topical issues and trends in a field of knowledge and contains articles that provide syntheses of research works, overview and reviews. Bulletin has between 4 – 32 pages in length describes statistics, research, training, technical assistance and also profile model programmes on a field of knowledge, which may be updated annually depending on the subject or as a part of a special series. Reports describe comprehensive research and evaluation findings. They provide detailed descriptions of innovations implemented at local, state and national levels, which can be case studies, field studies and other strategies used for assessing programme success.

Bird and Bird (1999) observed that refereed journals are the foundation of scientific communications, broadening the research base upon which a scientific discipline is built. Similarly, Xiao and Smith (2006) note that academic journals play significant roles in academic scholarship and this is why Zhang (2007) revealed that, on the international relevance and relation research, journal has an overwhelming dominance as reference sources.

Reporting on research productivity, Egwunyenga (2008) revealed that specialized research institutions the world over and Nigeria inclusive turns out chunk of research outputs in technical, annual and miscellaneous reports which relates to developmental

issues not only in the country but also within the region. The study by Javed and Shah (2008) revealed that 49.52% of citations pertained to journal articles and the rest to other resources types. This view was also shared by Gideon (2008) who reporting on Nigeria observes that scholarly publishing played a much greater role in terms of dissemination of information through scholarly journals. He pointed out that academic research is a focal point in Nigeria, compulsory for both lecturers and students, but particularly for lecturers who are affected by the concept of 'publish or perish' which has come to strap their subsistence and promotions making them to also rely on the academic environment and the volume of their research output and published works. Collaborating the above statement, Thanuskodi (2010) revealed that periodicals are the primary sources and channels of information dissemination. They are also important media for communicating the latest research findings, containing the current research development in any field of knowledge, which reflect and indicate literature growth. This is why Fagbola and Adejoro (2012) revealed that journals are more cited than other literature and most preferred sources of information. They attributed this to: currency of information, high rate of turnover of production, easy accessibility, frequency of production, which is faster than books and other primary sources. Attesting to the numerous sources of scientific information Wardika and Gudadhe (2013) argue that journal is one of the valuable primary sources because its literature cover new researchable information, ideas, concept, formula and research results. It may cover the depth information on micro thoughts, comparison of subjects, depth study of subjects or new developments in subject, and so on. Specifically, McCann (2013)

reported that electronic publications and formats are the most subscribed to and seen as the wave of the future when it comes to forms of scientific communication.

The influence of publications on research output is based on what is core to a subject field and medium of publication. Core publications are perceived by several authors centred on content and audience. According to van Raan and Leeuwen, (2002), core publications play important role in scholarship communication. Commenting on core Nigerian biomedical science resources, Nwagu (2007) categorically stated that these indices enable the examination of the growth of literature, which is also an indicator of the growth of science in Nigeria.

Although all literature reviewed indicate that research outputs are disseminated in various formats, most of them show the preference of journals over other forms of bibliographic formats. This may however be true only in the field of sciences and partly social sciences. The field of humanity is basically book based.

2.4 Quantitative Analysis of Research Outputs

Author productivity in research as noted by Creswell (1986) connotes the total research output made by an author within a given period of time. Accordingly, Millar and Senker (2000) state that a universal quantification approach to measuring research productivity was to count the number of books, articles, technical reports, bulletins, and books reviews published, as well as presentations given and grants received through

reviewing curriculum vitae or other print materials. Oloruntoba and Ajayi (2006) observed that research publication in the university is a major or most significant quantitative indicator of academic staff productivity, and that research attainment is determined by the number of published articles in refereed journals, numberof contributors and conference proceedings of repute.

In bibliometrics, authors' research productivity remains a significant area of study. It is a vital indicator of the dispersion of articles across fields of knowledge, contributors and the forms of their existence. Creswell (1986) argue that quantitative research productivity includes number of research publications in professional journals and in conference proceedings, number of books or chapters in books, gathering and analyzing original evidence, working with postgraduate students on dissertations and class projects, number of patents and licenses, monographs, technical reports, number of developed experimental designs, engaging in public debates and commentaries by scholars. The pivotal role of author productivity and research output of the Faculties of Agriculture, Veterinary Medicine and College of Agriculture in Nigeria was reported by Ibrahim (1997/98) to include teaching and supervision both essential activities in the conduct of research and training. Fairweather (1999) gave elements that influence research productivity to include socio-demographic characteristics, environmental conditions, social knowledge, self-knowledge, career and social contingencies for the understanding of faculty productivity. Middaugh (2001) measured faculty research activities and attributed

quantitative measures to number of refereed publications, number of text books, externally funded grants, professional conference papers, seminars, etc.

Aliyu (2011) accorded significance to quantitative research productivity of authors. He revealed the role quantitative analysis played in information of author productivity, dissemination, communication activities and contribution to the field of knowledge, which exist in different patterns such as single, joint and multiple authorships. Because of the important role quantitative analysis of author productivity play, Solu *et al*. (2012) revealed that, often, departments evaluate their faculty members on their "publication count", a measure of quantity.

2.5 Nature of Collaboration in Scientific Research Output

Publication trends and authors collaboration are relevant to knowledge generation studies. Mengxiong (1993) notes that, scientist are not only expected to develop knowledge; they are also required to share the knowledge they develop with other members through formal sources in order to be considered to have contributed to knowledge. According to Harande (2001), collaboration is the act of writing/publishing article by two or more authors.

Nwagu (2007) reported that authorship is tied with reputation, career success, remuneration and also held accountable for the claims made in the write up. That is why the appropriation of credit and the allocation of responsibility thus go hand in hand, and

this makes for a fairly straight forward social accounting. Earlier, Brodkey (1987) attributed fear, complexes and self-acclamation to influence the "lone scholar" consistency as observed in some fields. Kassierer and Angel (1995) observed that since the middle of the twentieth century, changes in the scientific arena have adjusted the nature and structure of scientific communication practices so that authorship has become almost a collective responsibility and therefore affects contribution to research productivity. Reporting on collective authorship, Cronin (2001) revealed that it could be as a result of trans-disciplinary, trans-institutional and trans-national collaboration among scientists who are aware that collaboration across national, disciplinary and boundaries could lead to path-breaking research output.

Research findings on author productivity and collaboration have been documented by Subramanyam (2007) who reported that collaborative work affects the visibility and productivity of scientists. He gave different forms of which authorship collaboration can exist: collaboration among colleagues, collaboration between organizations, Collaboration between teacher and pupil, collaboration between supervisor and assistant, researcher – consultant collaboration, and international collaboration. Arya and Sharma (2011) stipulated that today research has become interdisciplinary and scientists in one area have to collaborate with scientist in other areas in order to fulfill the goals of research objectives thereby increasing working in collaboration and to gain expertise in areas of specialization.

Zaki (2011) observed that the practice of "gift" authorship has undermined and significantly accounted for the inflationary increase in the number of authors. Gift

authorship according to him is co-authorship awarded to a person who has not contributed significantly to the study. However, reservations on collaborations has also been monitored to explain the predilection for such titles as "Death of Literature (Kernan, 1991), "The Death of the Author" (Barthes, 2001). The premises have been on consensus that multiple authorships actually undermine the assumptions commonly held about the nature and entitlements of authorship. Contradicting the aforementioned premises, Newman (2004) said that there is no clear cut, proof or standard capable of revealing the imbalance on the reputations of collaborative literature generally.

However, some observers have noted that co-authorship obstructs intuition in abstracting and indexing services in libraries. Usually, abstractors and indexers create spaces in their indexes for expected publications based on the anticipation of the average number of authors per paper. Cronin (2001) has narrated a series of problems that have been encountered by the National Library of Medicine's (U.S.A.) pegging of the maximum number of authors of any paper to two, which has often led to complaints from co-authors whose names were omitted in an index of papers to which they have made contributions thereby showing the inadequacy of complete communication. However, collaboration has been adjudged to reflect awareness of current authorship practices. Contradictory is the existing dilemma in the Guidelines for the Promotion of Academic Staff in Nigeria Universities which provided that co-authored papers are rated lower than sole-authored papers during staff promotion processes despite the evidence in literature that multiple-authored papers have a higher impact than the sole-authored ones even also with the

recognition by the Nigerian Copyright (2004) which made provisions for the management of joint-authored papers and other jointly-owned intellectual properties.

2.6. Research Output in Agriculture and Related Fields

Research outputs refer to results in research reports, books and chapters in books, journal articles and conference papers to mention but few. To appreciate what research output is, it is imperative to define research. Research according to Griffin University (2013) is any undertaken activity that creates new knowledge and/or use existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings. This could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes; therefore, implying that a research output as the output of research. University of Auckland (2012) characterized research output to be publications (public dissemination, presentation, performance or exhibition). They caterorized research output into journals, conference contribution, chapter, report, thesis/dissertation, book, performance, artifact, patent/trademark, exhibition, scholarly edition, software, composition, internet publication, design, confidential research output. These categories also have sub-categories such as review, oral presentation, dataset, craftwork, object, film/TV/video, translation, doctoral thesis, masters' thesis, working paper, technical report in formal proceedings, abstract, discussion paper, editorial comment, corrigendum, rapid communication, letter, etc. The aggregation presents the capacities of research output in each media which remains a significant indicator for quantification of research output.

Agricultural research output depicts preferred mediums and formats through which research findings are communicated by faculty members. Hawkes, Turner and Waage (2012) identified pathways by which research outputs contribute directly and indirectly to inform agricultural stakeholders. They reported key players of agricultural research output to include academics and research institutions, non-governmental organizations, private sectors and inter-governmental agencies.

Edge *et al*. (2012) opined that to gain greater understanding of researcher behavior and attitudes in relation to communicating research outputs, factors driving researchers to work and to interact, motivations, institutional/organizational support are very important and have much influence over individuals' behavior, and also, persisting that making research output freely and openly available can be in the hands of the individual. They mention barriers to research output and access to resources to include lack of required resources and of institutional policies to drive these activities, routes to communicate research results not relying on traditional routes of print publishing in journals, books and appearing at conferences alone, patronage of digital formats and hosting on institutional repositories should be encouraged.

A systematic review of studies by Girard *et al*. (2012) observed that the evaluation of agricultural intervention and research output for improved nutrition have been affected negatively by poor evidence of impact and implementation, therefore, solicited for more and better ways of reporting, designing and targeting recipient/audience in order to provide comprehensible information on the pattern and direction of research to overturn failures of

putting research output into practice. Conclusively, Coote *et al.* (2011) insist that research output centred on the introduction and adoption of technology must be able to examine uptake by farmers, critique by academics, laboratory/field evaluation and replication, effect of value chain, dynamics and be predictive from empirical studies.

2.7 Application of Lotka's Law of Scientific Productivity on Authorship Patterns

Authorship patterns discloses and facilitate documentation of statement of authority of a scholarship. Sudhier (2013) reported authorship patterns to be the classification and description showing contributor(s) in any literary endeavour. According to Ahmad, Jan and Khan (2012), Lotka Law of authorship pattern was proposed to ascertain the number of authors of scientific papers and the number of contributions (research articles) made by each contributor. He concentrated on the distribution of articles among great number of authors.

Theoretically, Lotka was able to show the part which men of diverse levels contribute to advancement of science by counting the number of individual authors and the number of contribution made by each one of them in the decennial index of Chemical abstracts from 1907-1916. However, Lotka plotted only the principal authors whose names begun with letters A and B. Plotting these data on a logarithmic scale, the number of authors on one side against the number of papers by each author on the other, he came to know that in each case the points were closely scattered about a straight line having a slope of approximately two to one. He stated the occurrence of publication by contributors in a

given subject as, "the number (of author) making "n" contributions is about $1/n^2$ (n=1,2,3….) of those making one: and the proportion of all authors, that make a single contribution, is about 60% "this mean that out of all the contributors in a given subject, about 60% published only one article each, 15% (if n = 2, $1/n^2$, then $1/2^2$ times) published two articles each, 7% (if n = 3, $1/n^2$, then $1/3^2$ times) figure published three articles and so on. According to Lotka only 6% contributors in a subject area published more than ten contributions.

Reporting on the historical application of Lotka's law, Murphy (1973) in Hertzel (1987) applied it to the field of humanities and found it to be at par with the findings of Lotka even though he did not make any statistical test to check the significance degree reported by Lotka. Also, Sen, Taib and Hassan (1996) tested Lotka's law in information science and fount it applicable. Similarly, applying Lotka's Law, Egghe (2005) found that there was no ambiguity in the fix number of authors and the number of publications as stated by Lotka, this implied that both the mathematical expression are the same even though in Lotka's original paper there was no suggestion that this was a universal law applicable to all branches of knowledge.

It is arguably proven by Ahmad, Jan and Khan (2012) that the application of Lotka's Law in some fields fit while in some it did not. They were able to proof this from several studies where authors made wrong calculations and not exactly applied Lotka's Law.

2.8 Summary of the Review of Related Literatures

This chapter reviewed various literature that centred on bibliometric analysis of research output of researchers. The chapter reviewed seven conceptual models of research output, out of which two models were modified and adopted for this study. With regards to research output formats, faculty members in the agriculture and veterinary complex of Ahmadu Bello University, Zaria chose and disseminate most of their research findings in journals.

Literature on quantitative analysis of authors' research outputs revealed responsibilities and roles of research output as a dictator of existence and influence of research. The literature reviewed have been able to proof that research output have direct and indirect consequences on stakeholders who also depend on academics and research institute, non-governmental organizations, private sectors and inter-governmental agencies for the production of research output.

Literature reviewed on the quantification analysis of authors research outputs were at par with research output format. Here also literature revealed authors preference to journals, professional conference papers, seminars, books, chapters in books, etc. However, counting the number of journal articles, conferences, patents, monograph are not the only metric applicable; socio-demographic characteristics, career and social contingencies were also elaborated as universal norms for the quantitative metrics of research output. The review of literatures on the application of Lotka's law on authorship

patterns showed the extent of collaboration and support for publishing of research output.The review revealed that Lotka has been able to state the benefits and encourage the sharing and diversification of fields. However, some literature reviewed cautioned on the application of the law on fields of knowledge stating that researchers must ensure it conforms to correct calculation and utilization of procedures as prescribed by Lotka.

On the nature and extent of collaboration, literatures reviewed supported target orientation papers whose outcomes rely on project, programmes and student supervision as the prevalent avenues that foster greater understanding of researcher behaviour, the factors responsible for research work, the roles of institution, motivations and literary interactions. Literature affirmed that the shift to multiple authorships is a revelation of collective responsibility for the purpose of obtaining certified results and that discipline are now interwoven. The verification and impact of research output is widely acceptable when it is trans-institutional and trans-national on one hand, and on another, create awareness, replication across boundaries which is envisaged to lead to path-breaking research output.

REFERENCES

Ahmad, S., Jan, S.U. & Khan, F. (2012). Lotka's Law of Scientific Productivity: Theory and Application. *PUTAJ Humanities and Social Sciences,* 127 – 134.

Aliyu, M. (2011). Author Productivity and Collaboration Among Academic Scientists in Modibbo Adama University of Technology, Yola. *The Information Manager* 11(1&2): 32 – 35.

Arya, C. & Sharma, S. (2011). Authorship Trends and Collaborative Research in Veterinary Sciences: A Bibliometric Study. Chinese Librarianship: An International Electronic Journal, 34. URL: http://www.iclc.us/cliej/cl34AS.pdf

Barthes, R. (2001). "The Death of the Author". *The Norton Anthology of Theory and Criticism*. Ed. Vincent B. Leitch. New York: W.W. Norton & Co.

Bird, J.E. & Bird, M.D. (1999). Do Peer-Reviewed Journal Papers Results from Meeting Abstracts of the Biennial Conference on the Biology of Marine Mammals? *Scientometrics* 46(2): 295.

Bland, C.J., Center, B., Finstad, D.A., Risbey, K. & Staples, J.G. (2005). A Theoretical, Practical, Predictive Model of Faculty and Department Research Productivity. *Academic Medicine* 80(3):225 – 237.

Bland, C.J., Seaquist, E., Pacala, J.T., Center, B. & Finstad, D. (2002). One School's Strategy to Assess and Improve the Vitality of Its Faculty. *Academic Medicine* 77:368 – 376.

Brocato, J.J. (2001). The Research Productivity of Family Medicine Department Faculty: A National Study Dissertation, Michigan State University.

Brodkey, L. (1987). *Academic Writing as Social Practice*. Philadelphia: Temple University Press.

Coote, C., Tomlins, K., Massingue, J. Okwadi, J. & Westby, A. (2011). Understanding Consumer Decision Making to Assist Sustainable Marketing of Vitamin A-Rich Sweetpotato in Mozambique and Uganda. 2020 Conference Note 2. Washington, D.C.: International Food Policy Research Institute.

Creswell, J.W. (1986). *Measuring Faculty Research Performance*. San Francisco Jossey-Bass. 120p.

Creswell, J.W. (1985). Faculty Research Performance: Lessons From the Sciences and Social Sciences. Washington, DC: Association for the Study of Higher Education.

Cronin, B. (2001). Hyper-Authorship: A Post Modern Perversion or Evidence of a Structural Shift in Scholarly Communication. *Journal of American Society for Information Science* 52(7): 558 – 569.

Dundar, H. & Lewis, D.R. (1998). Determinants of Research Productivity in Higher Education Research. *Higher Education* 39:607 – 631.

Edge, P., Martin, F., Rudgard, S. & Thomas, N.M. (2012). Research Attitudes and Behaviour Towards the 'Openness' of Research Outputs in Agriculture and Related Fields. Paper Prepared for Coherence in Information for Agricultural Research for Development (CIARD), 18p.

Egghe, L. (2005). Relations Between the Continuous and the Discrete Lotka Power Function. *Journal of the American Society for Information Science and Technology*, 56(7): 1-13.

Egwunyenga, E.J. (2008). Dystrophies and Associated Crises in Research and Academic Publications in Nigerian Universities. *Anthropologists* 10(4):245 – 250.

Fagbola, B.O. & Adejoro, M.A. (2012). Citation Pattern of the Nigerian Journal of Horticultural Science from 1990 – 2005. *Library Philosophy and Practice (e-journal)* Paper 715. Available @ http:digitalcommons.unl.edu/Libphilprac/715.

Fairweather, J.S. (1999). The highly productive faculty member: Confronting the mythologies of faculty work. In: W.G. Tierney, ed. Faculty productivity: Facts, fictions, and issues (New York: Falmer Press), 55-98.

Finkelstein, M.J. (1984). The American Academic Profession: A Synthesis of Social Scientific Inquiry Since World War II. Columbus: Ohio State University Press.

Gideon, E.C. (2008). Issues and Challenges to the Development of Open Access Institutional Repositories in Academic and Research Institutions in Nigeria. A Research Paper Prepared for the International Development Research Centre (IDRC), Ottawa, Canada. 64p.

Girard, A., Self, J., McAuliffe, C. & Oludea, O. (2012). The Effects of Household Food Production Strategies on the Health and Nutrition Outcomes of Women and Young Children: A Systematic Review. *Paediatric and Perinatatal Epidemiology* 26(1): 205 – 222.

Griffith University (2013). Research Plan 2013 – 2017. Available online at http://www.griffith.edu.au/__data/assets/pdf_file/0008/535922/20431_13-RESEARCH-2013-2017FINALweb. Accessed 16th May, 2013, 26p.

Harande, Y.I. (2001). Author Productivity and Collaboration: An Investigation of the Relationship Using the Literature of Technology. *Libris* Vol., 51: 124 – 127.

Hawkes, C., Turner, R. & Waage, J. (2012). Current and Planned Research on Agriculture for Improved Nutrition: A Mapping and a Gap Analaysis. A Report for DFID in Collaboration with Leverhulme Centre for Integrative Research on Agriculture and Health, University of Aberdeen and Centre for Sustainable International Development, 48p.

Hertzel, D.H. (1987). Bibliometrics: History of the Development of Ideas. In: *Encyclopedia of Library and Information Science*, New York: Marcel Decker, 42: 169 – 173.

Ibrahim, U. (1997/98). Quantitative Analysis of Current Scientific Research and Productivity in IAR and NAPRI, Zaria, Nigeria. *Library Focus* 15& 16: 36 – 42

Javed, M. & Shah, S.S. (2008). Rawal Medical Journal: An Analysis of Citation Pattern. *Rawal Medical Journal* 33(2): 254 – 257.

Kassierer, J.P. & Angel, M. (1995). On Authorship and Acknowledgements. *New England Journal of Medicine* 325: 1510 - 1512.

Kernan, A. (1991). The Death of Literature. *The Georgia Review* 45(1): 186 – 191.

Le Boeuf, P. (2006). "... That struts and frets his hour upon the stage and then is heard no more ...": the elements that should be accounted for in a conceptual model for performing arts and the information relating to their archives . *Paper presented at the workshop "De la conception à la survie: comment documenter et conserver les productions du spectacle multimédia ?" Paris, Centre de documentation de la musique contemporaine, as part of the "Rencontres itinérantes" "Quelles noces de la musique et de l'image ?"*, 13 January,10p.

Ligthelm, A.A. & Koekemoer, E.M. (2009). Academic publishing: Lessons Learnt From the Southern Africa Business Review. *Southern Africa Business Review* 13(3): 28 – 50.

McBurney, M.K. & Novak, P.L. (2002). "What Is Bibliometrics and Why Should You Care?" In: *Reflections on Communication: Proceedings of IEEE International Professional Communication Conference, Portland, Oregon, September 17-20,* pp. 108-114. IEEE, Piscataway, NJ.

McCann, L. (2013). Academic Use of Electronic Publications in Social Sciences and Humanities and Changing Roles for Libraries. Association of College and Research Libraries.

Mengxiong, L. (1993). Progress in Documentation. The Complexities of Citation Practice: A Review of Citation Studies. *Journal of Documentation* 49:390.

Middaugh, M.F. (2001). Understanding Faculty Productivity: Standards and Benchmarks for Colleges and Universities.(San Francisco: Jossey-Bass). 160p.

Millar, J. & Senkar, J. (2000). International Approaches to Research Policy and Funding: University Research Policy in Different National Contexts; University of Sussex: SPRU Science and Technology Policy Research. 46p.

Newman, M.E.J. (2004). Coauthorship Networks and Patterns of Scientific Collaboration. *PNAS* 101(1):5200 – 5205. Available at www.pnas.org/cgi/doi 10.1073 pnas.0307545100, accessed on 14/07/2014.

Nigerian Copyright Act (2004). Cap 28 Laws of the Federation of Nigeria. 33p. Available at www.copyright.gov.ng/index.php/.../nigerian-copyright-act-lfn-2004 accessed 14/07/2014.

Nwagu, W.E. (2007). Patterns of Authorship in the Biomedical Literature of Nigeria. *LIBRES* 17(1) March. URL: http://Libres.curtin.edu.au/

Oloruntoba, A. & Ajayi, M.T. (2006). Gender and Research Attainment in Nigerian Agricultural Universities. JHEA/RESA 4(2):83 – 98.

Qui, L. (1990). An Empirical Examination of the Existing Model for Bradford's Law. *Inf. Proc. Manage.,* 26(5): 655 – 672.

Ramirez, Y.W. & Nambband, D.A. (2004). Measuring Knowledge Worker Productivity: A Taxonomy. *Journal of Intellectual Capital* 5(5):602 – 628.

Sen, B.K., Taib, C.A. & Hassan, M.F. (1996). Library and Information Science Literature and Lotka's Law. *Malaysian Journal of Library and Information Science,*1(2): 89 – 93.

Solu, T., Kendagor, R., Kosgei, D., Tuitoek, D. & Chelangat, S. (2012). Factors Affecting Research Productivity in Public Universities of Kenya: The Case of Moi University, Edoret. *Journal of Emerging Trends in Economics and Management Sciences* (JETEMS) 3(5): 475 – 484.

Subtramanyam, F. (2007). Bibliometric Studies of Research Collaboration: A Review. *Journal of Information Science* 5:36.

Sudhier, K.G. (2010). Application of Bradford's Law of Scattering to the Physics Literature: A Study of Doctoral Theses Citations at the Indian Institute of Science. *DESIDOC Journal of Library & Information Technology* 30(2): 3 -14.

Sudhier-Pillai, K.G. (2013). Lotka's Law and Pattern of Author Productivity in the Area of Physics Research. *DESIDOC Journal of Library & Information Technology* 33(6): 457 -464.

Teodorescu, D. (2000). Correlates of Faculty Publications Productivity: A Cross-National Analysis. *Higher Education* 39:201 – 222.

Thanuskodi, S. (2010). Journal of Social Sciences: A Bibliometric Study. *Journal of Social Sciences* 24(2): 77 -80.

University of Auckland (2012). Definition and Categories of Research Outputs. Available online at https://policies.auckland.ac.nz/policy-display-register/authorship-guidelines.pdf. Accessed 16th May, 2013. 4p.

Van Raan, A.F.J. & Van Leeuwen, T.N. (2002). Assessment of the Scientific Basis of Interdisciplinary, Applied Research Application of Bibliometric Methods in Nutrition and Food Research. *Research Policy* 31:611 – 632.

Wardikar, V.G. & Gudadhe, V.P.C. (2013). Application of Bradford's Law of Scattering to the Literature of Library and Information Science: A Study of Doctoral Theses Citations Submitted to the Universities of Maharashtra, India. *Library Philosophy and Practice (e-journal).* Paper 1054. Retrieved February 28, 2014 from http://digitalcommons.unl.edu/libphilprac/1054.

Wilkinson, E.A. (1972). Ambiguity of Bradford's Law. *Journal Documentation*, 28: 122 – 130.

Xiao, H. & Smith, S.L.J. (2006). The Making of Tourism Research: Insights from a Social Sciences Journal. *Annals of Tourism Research* 33(2): 490 – 507.

Zaki, S.A. (2011). Gift Authorship – A Cause of Concern. *Lung India* 28(3): 232 – 233.

Zang, L. (2007). Citation Analysis for Collection Development: A Study of International Relation Journal Literature. *Library Collection, Acquisition and Technical Services* 31: 195 – 207.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter is presented under the following sub-title: Research methodology adopted for the study, population of the study, sample and sampling technique, instrument used for data collection, data collection procedure and the statistical technique used for data analysis.

3.2 Research Method Adopted for the Study

The study relied on bibliometric methods to undertake quantitative study on research productivity of the faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria. The method facilitates the measurements of publication output, nature of publications, collaborations and the verification of bibliometric laws. According to Hertzel (2003), bibliometric analysis is a productivity measure of publication counts, amount of research income, number of students supervised, size of research group, number of projects undertaken, views and download of online output, number of patents and licenses obtained. The application of bibliometrics according to Polanco (1995) is to describe, evaluate and monitor research. Ziegler (2009) reported bibliometric methods to be very suitable for the description of research surrounding a particular field, or similarly, the quantity and focus of research output by a particular organization. As an evaluation method, it helps in the determination of the impact a technology or the effectiveness of an

author or research organization. Finally, it serves as a monitoring tool in that it can be used to track the level of activity in a research field over time.

Quantitatively, it is descriptive and can be used to investigate how the aforementioned parameters amount to literature productivity of countries, institutions, time periods and disciplines or subject. Qualitatively, it can be used for the analysis of literature usage count on reference and citation.

This research method is found to be very appropriate for the study because as observed by Jacobs (2001), it facilitates ascertaining the exact number of research output published through counting and basing it over a period of time. It also helps to assess research productivity performance at individual, group, institutional, national and international levels. The method efficiency enable producing a variety of statistics quite quickly when compared to the resource-intensive nature of others employed to assess the quality and innovations of intellectual thoughts.

3.3 Population of the Study

The population comprise of the six units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria and their respective faculty members. These units comprise of Institute for Agricultural Research (IAR), Division of Agricultural Colleges (DAC), National Animal Production and Research Institute (NAPRI), Faculty of Agriculture (FOA), National Agricultural Extension and Research Liaison Services (NAERLS) and The Faculty of Veterinary Medicine and Teaching Hospital (FVM&TH). According to ABU MIS (2013), there are a total of 545 faculty members in the Agriculture

and Veterinary Complex of Ahmadu Bello University, Zaria. Therefore, this total number of staff constituted the population of the study. However, the subjects were professors and associated professors only. Table 3.1 shows the distribution of staff that constituted the faculty members in the complex.

Table 3.1: Distribution of faculty members in the Agriculture and Veterinary Complex, ABU., Zaria

Composition of faculty members	**Name of unit and number of academic staff in**						**Total**
	IAR	DAC	NAPRI	VET	FOA	NAERLS	
Professor	16	3	18	23	21	5	86
Associate Professor/Reader	5	2	3	18	8	4	40
Principal/Senior Lecturer	12	7	6	18	16	8	67
Lecturer I	6	8	7	13	20	11	65
Lecturer II	8	42	-	29	11	27	117
Assistant lecturer	19	55	-	21	11	26	132
Graduate Assistant	4	23	-	-	-	11	38
Total	**70**	**140**	**34**	**122**	**87**	**92**	**545**

Source: ABU MIS, 2013

3.4 Sample and Sampling Technique

The sample for the study were faculty members drawn from the six units that make up the Agriculture and Veterinary complex of Ahmadu Bello University, and those promoted between 2002 to 2012 unto the categories of professors and associate professors. These categories of faculty members provide documented evidence of proof of their published research works to the Central Committee for authentication and verification.

The sampling technique adopted was stratified random sampling. Stratified random sampling requires that population are shared into stratum that shares at least one common characteristic (Castillo, 2009). According to Ibrahim (2013) stratified random sampling is commonly used probability sampling method that is superior to random sampling because it reduces sampling error. The choice of the stratified random sampling is to ensure that the population of the six units whose subjects are not evenly distributed are proportional to supply the sample size that provides adequate documents that can be used for generalization and also guaranteeing that subjects from each stratum are inclusive. However, to operationalize the stratification technique, the study relied on Ibrahim's (2013) procedure which recommended sub-grouping to reduce sampling errors and facilitate random sampling of selected subjects to attain the proportional representation of the population.

The complex has a population of 545 faculty members, 124 (23%) represents the total of professors and associated professor add together; however, of these, 38 were found to be eligible for the study because their promotions fell within the scope of the study period of 2002 – 2012 (ABU MIS, 2013). The 38 faculty members were automatically the subject of the study because the size is small, and therefore, the study sample size. These faculty members constituted 30% of the 124 subjects from the complex. Inferentially, a sample size of 30% according to Afolabi (1993) is sufficient for generalization and a good representation of a target population.

3.5 Instrument for Data Collection

The instrument used for data collection is the bound copies of faculty members' curriculum vitae and publications, and a computer system. The instrument must however, be those submitted and screened bound by the Central Committee charged by the University to appoint and promote staff. The computer system was utilized for recording numerical data extracted from the selected bound copies.

The choice of the bound copy as data collection instrument is based on the fact that, it is the most reliable source for data collection on faculty members research output that is readily available, in standardized format, comprehensive and true proof of research output claimed by faculty members. The use of this type of database is supported by Bornmann *et al*. (2008) who proposed the use of a reliable database, sufficient with and formulated quality control criteria that comprise authenticity, credibility, representativeness and meaning. This also remains the criterion on which faculty members who ascend the positions of associate professors and professors must possess. Using computer for data collection will facilitate sorting, storage, retrieval and analysis

The standard for presentation of the bound curriculum vitae and publications for faculty members belonging to the Agriculture and Veterinary Complex is the same; it is made up of nine parts. The first part is a comprehensive curriculum vitae of the affected faculty member, the second part contains only peer-reviewed journal articles published, third part comprised of all edited conference proceedings, fourth are unedited conference

and seminar papers, fifth are for books published by faculty member, sixth are the published chapters in books, seventh is concerned with technical reports written, eight are the bulletins/magazines/newspaper, etc publications and ninth is the section designated to show innovations. For this study, the second to the eight parts will remain the focus of this research work.

3.6 Data Collection Procedure

This was done by direct counting and recording of item by item contained in the bound staff curriculum vitae and publications and as itemized by the study research questions and objectives. Data extracted werepooled under appropriate titles to achieve the study objectives and for data analyses recorded in computer files created in Excel spreadsheet (a component of Microsoft Office for mathematical operations).

Data collection lasted for two weeks because of the proximity and access to the complex faculty membership by the researcher.

3.7 Statistical Technique for Data Analysis

Data collected were subjected to two statistical techniques for analyses; the descriptive and inferential statistics.

Descriptive statistical technique: This technique was employed to aid the extraction of identified collocating objectives of the bound publications, their classifications and for drawing statistical graphs. Other forms of description were for the presentation of data in frequencies, percentages and rank distributions. The statistical technique was utilized to answer research question 1 and achieve objective 1 of the study.

Inferential statistical technique: To generalize and ascertain author productivity distribution, and the conformity to Lotka's law. A comparison of the maximum difference was done using a Non-parametric Chi-square test at significance level of 0.01% probability level. The test determines levels of associations. Association in statistical sense inferred to making a comparison due solely to chance factors of sampling, and for other reasons which might be attributable to random causes. The probability that a difference as great or greater than that obtained could have arisen in this way. The test was used to achieve objective 5, and answer research question 5 respectively. It is mathematically expressed as:

$$\chi^2 = \Sigma \frac{(Observed\ frequency - Expected\ frequency)^2}{Expected\ frequency}$$

The choice of Chi-square was necessitated to be able to collect data in the nature of bibliometric variables for analysis. The use of Chi-square will expose the general relationships and associations of the research output variables. It is noteworthy, that Chi-square is exhaustive when it classify its population either as dichotomous or multiple, and the division in Chi-square is mutually exclusive. A classification is exclusive when it provides sufficient categories to accommodate all members of the population.

Theprinciple of generalization using Chi-square is that, when the Chi-square calculated is greater than Chi-square critical (table), the sample distribution does not fit the theoretical distribution of Lotka's law, but when it is less than, it fits.

REFERENCE

ABU MIS (Ahmadu Bello University Management Information Services) (2013). List of Academic Staff. 20p. Directorate, Management Information Systems.

Afolabi, M. (1993). Introduction to Research Method for Writing Project and Thesis, Zaria, Alpha Publishers.

Bornmann, L., Mutz, R., Neuhaus, C. & Daniel, H.D. (2008). Citation Counts for Research Evaluation: Standards of Good Practice for Analyzing Bibliometric Data and Presenting and Interpreting Results. *Ethics in Science and Environmental Politics* 8: 93 – 102.

Castillo, J.J. (2009). Stratified Sampling Method. Retrieved March 2012 from Experiment Resources: http://www.experiment-resources.com/stratified-sampling.html

Ibrahim, U. (2013). Techniques for Writing and Presentation of Thesis/Dissertation: A Companion Guide for Postgraduate Students in Nigeria University System.- Zaria, ABUP, 95p.

Jacobs, D. (2001). A Bibliometric Study of the Publications Patterns of Scientists in South Africa 1992 – 96, with Particular Reference to Status and Funding. *Information Research*, 6(3). Available at: http://InformatR.net/6-2/paper104.html. Accessed 27/3/2014.

Polanco, X. (1995). Infométrie et ingénierie de la connaissance, in J.-M. Noyer (Ed.), Les sciences de l'information bibliométrie scientométrie infométrie, Rennes, Presses Universitaires de Rennes

Ziegler, B.E. (2009). Methods for Bibliometric Analysis of Research: Renewable Energy Case Study. Master of Engineering in Electrical Engineering and Computer Science Submitted to the Department of Electrical Engineer and Computer Science, Massachusetts Institute of Technology.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents data collected for the study as presentations, analysis and discussion made in the following headings: Response rate and data analysis.

4.2 Response Rate

Out of the 38 members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria purposively selected for the research work, 33(86.84%) submitted their approved Curriculum vitae and publication for analysis. The high response rate could be attributable to proximity of the researcher to the complex which enabled him to repeat visits severally within a day, and the two formal letters from the Department to the appropriate avenues aided the high response rate and data collection (Appendix 1 and 2). The distribution frequencies and percentages for each unit is presented in Table 4.1.

Table 4.1: Response rate distribution

Unit	Sample size	Response frequency rate	Percentage response
FOA	9	9	23.68
DAC	2	2	5.26
IAR	6	6	15.79
NAPRI	6	5	13.16
NAERLS	3	3	7.89
VET	12	8	21.05
Total	**38**	**33**	**86.84**

Key: DAC = Division of Agricultural Colleges; FOA = Faculty of Agriculture;
IAR = Institute for Agricultural Research; NAPRI = National Animal Production and Research Institute;
NAERLS = National Agricultural Extension and Research Liaison Services;
VET = The Faculty of Veterinary Medicine and Teaching Hospital

4.3 Data Analysis

This section sought to analyse data collected with respect to the four research questions and one hypothesis raised in the study. The analysis was followed by discussion on the findings and highlighting some implications of the findings as well as testing the hypothesis.

4.3.1 Research Output Formats of Faculty Members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 - 2012

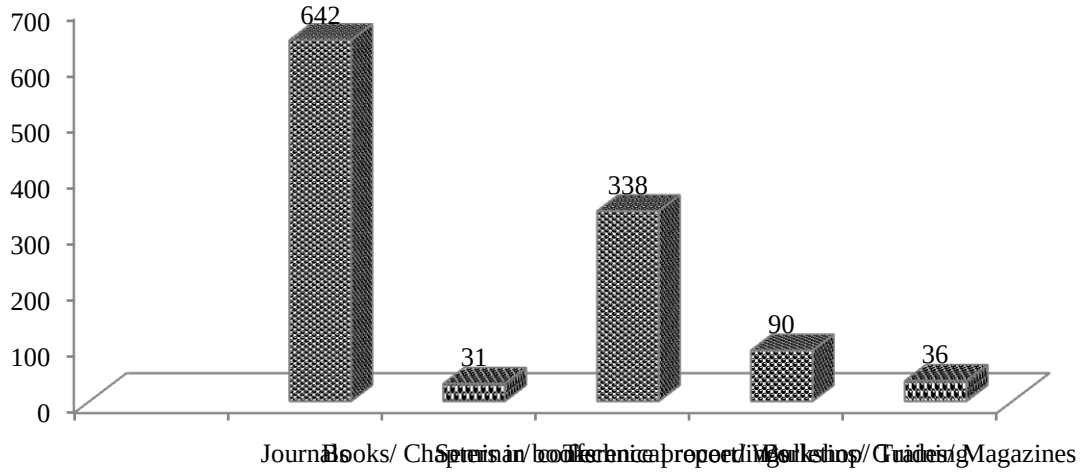
The first research question of the study set out to find out the different bibliometric formats in which members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria produce their research output. The reason for this investigation is to find out if this agrees with other literature as well as to see the numerous avenues for the dispersion of knowledge. The result is presented in Table 4.2.

Table 4.2: Frequency distribution of the research output formats of faculty members' of the Agriculture and Veterinary complex of Ahmadu Bello University, Zaria from 2002- 2012

Research output formats	Units of the complex						Cumulative total	% score
	DAC	FOA	IAR	NAERLS	NAPRI	VET		
Journals	31	181	192	39	57	142	642	56.46
Books/chapters in books	7	6	3	2	6	7	31	2.73
Seminar/ conference proceedings	34	84	115	19	21	65	338	29.73
Technical report/ workshop/ training	-	14	38	19	18	1	90	7.92
Bulletins/ Guides/ magazines	-	10	13	5	-	8	36	3.16
Total	72	295	361	84	102	223	1137	100

Key: DAC = Division of Agricultural Colleges; FOA = Faculty of Agriculture;
IAR = Institute for Agricultural Research; NAPRI = National Animal Production and Research Institute;
NAERLS = National Agricultural Extension and Research Liaison Services;
VET = The Faculty of Veterinary Medicine and Teaching Hospital

Fig. 1: Distribution of research output formats by faculty members in the Agric. and Vet. complex from 2002 - 2012



From the Table 4.2 and Figure 1, it can be clearly seen that journals recorded the highest scores of 642 (56.46%) as the most bibliographic format in which faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria publish their research works. This corroborates with reports by Thanuskodi (2010), Fagbola and Adejoro (2012) and Wardika and Gudadhe (2013) who reported that journals are the most patronized medium for sharing of research findings by academics. It is also regarded as the most recognized and highly scored media for promotions, gratifications and publicity of faculty members. Faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria like their counterparts in the other fields of science also highly utilize seminars and conferences as avenues to make known their research findings. This is indicated by the formats ranking second with 338 (29.73%). It is understandable that books/chapters in books came last with 31 (2.73%) because as indicated in many literature, scientists prefer journals to books.

However, it is surprising that technical report and bulletin/guides also recorded very low, with no presence in DAC and NAPRI. The reason for their low presence and absence in these units could be attributable to what Jacobs (2001) revealed that the formats do not attract promotion or add to their prestige.

4.3.2 Authorship Patterns of Faculty Members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria Research Output From 2002 to 2012

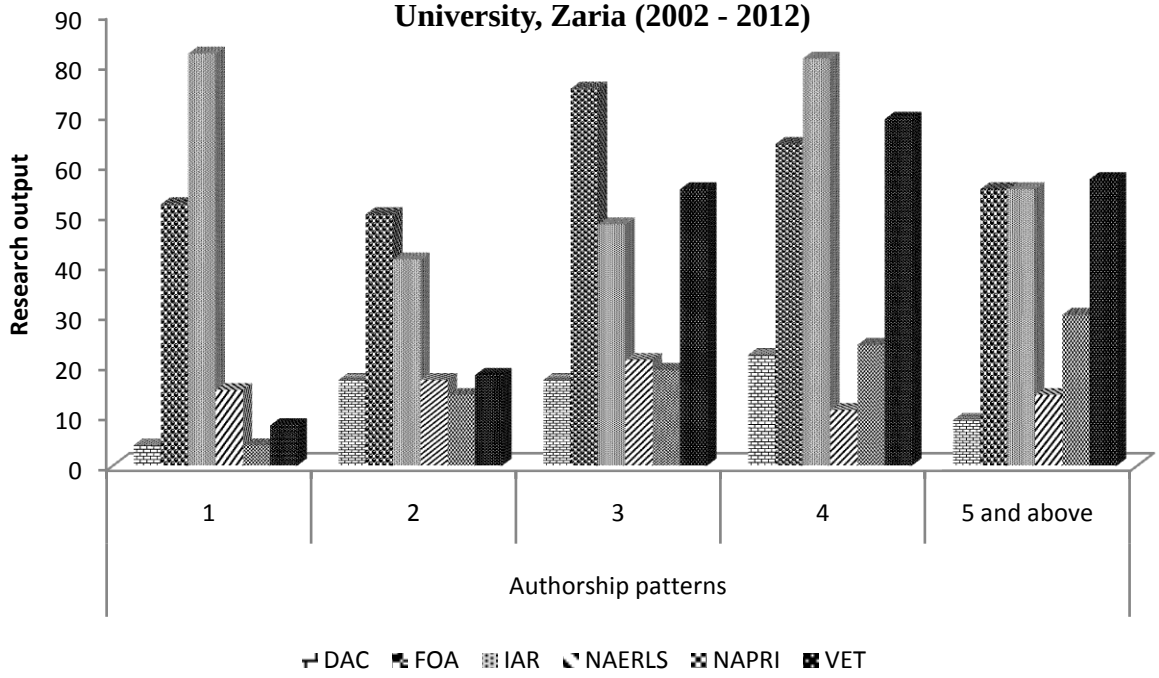
The second research question aimed at finding out the authorship patterns in the faculty members research output of the Agriculture and Veterinary Complex of Ahmadu

Bello University, Zaria. The authorship pattern is determined as a single and multiple authors of two, three, four and five and above. This is presented in Table 4.3 and Figure 2.

Table 4.3: Authorship patterns

Unit	Number of author(s) per publication				
	1	**2**	**3**	**4**	**5 and above**
DAC	10	23	22	28	15
FOA	43	31	69	58	49
IAR	87	48	57	90	65
NAERLS	19	21	32	18	22
NAPRI	8	18	23	29	32
VET	13	17	56	73	61
Total	180	158	259	296	244

Fig. 2: Graphical presentation of authorship patterns of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria (2002 - 2012)



The result of the analysis of the data as shown in Table 4.3 and Figure 2 revealed that research output of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria is dominated by multiple authorships, indicating high collaboration rate. Collectively, 957 (84.16%) research output are made up of 2 and above authors, with 180 (15.83%) single authorship. Erlen *et al.* (1997) gave the domineering reasons of multiple authorship to the increase in multidisciplinary collaboration and for purposes of research expansion. Ahmad, Jan & Khan (2012) and Mengxiong (1993) reported that multiple authorship support the sharing of knowledge when developed with others.

The prominent authorship pattern was joint authorships with 4 authors per paper which had a frequency distribution score of 296 (26%). However, Edge *et al*. (2012) attribute researcher behaviour and attitude towards each other to be the major factor driving academics to work with others, interact, motivate and also to support each other, and making research output freely and openly available.

The scoring and ranking of multiple authorship as presented in the Table 4.3 shows IAR toping with 260 (22.86%) of 2 and above. This is closely followed by FOA and VET with 207 (18.20%). It is understandable that DAC scored the lowest of 88(9.20%) of multiple authorship. This could be attributable to the fact that the division has far less ranks of associate professors and professors targeted by the research. It could also be because the unit awards the National Diploma (ND) and the Higher National Diploma (HND) which staff with First as well as Master degrees qualificationsare sufficient to teach but not meeting the criteria for their selection as stipulated in this study.

4.3.3 Nature of Collaboration Among Faculty Members of the Agriculture and Veterinary Complex, Ahmadu Bello University, Zaria From 2002 to 2012

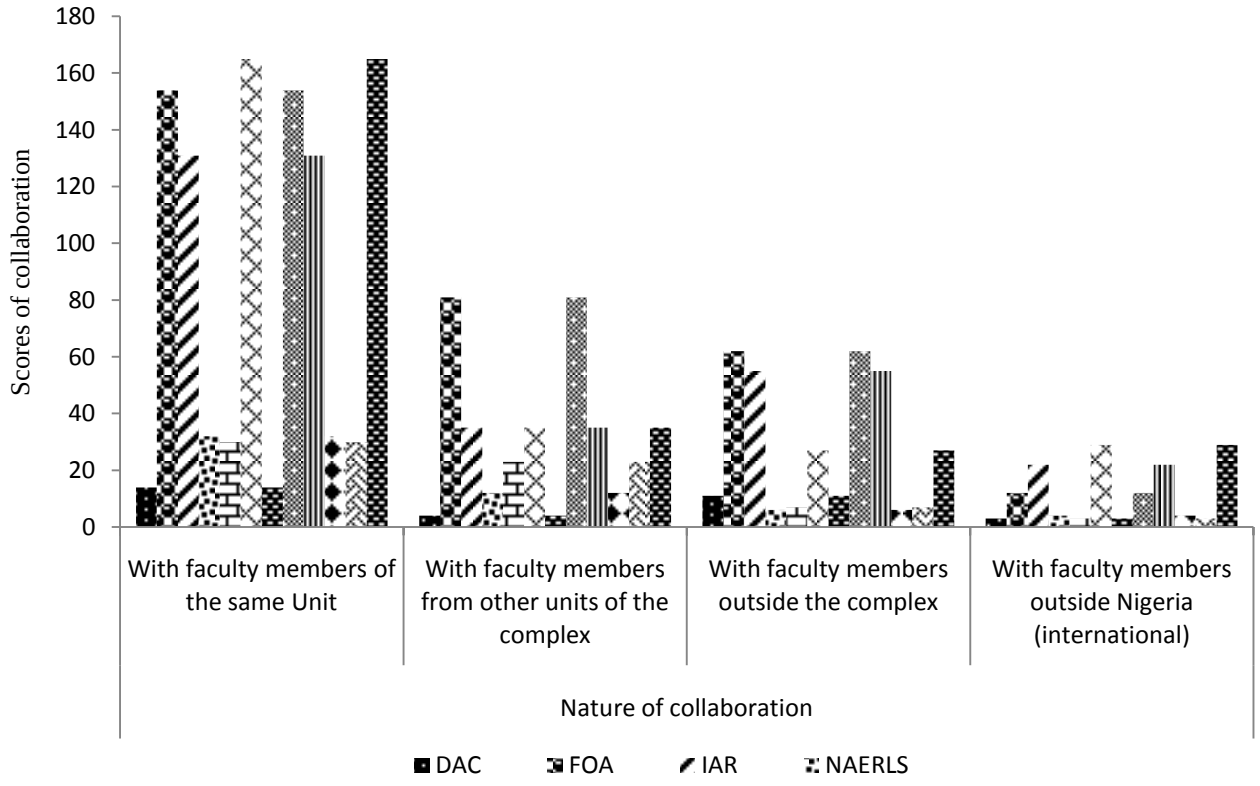
Collaboration has been reported as a very significant component of research productivity. As one of the primary variable of the study, a research question was raised to determine the nature of collaboration among faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University from 2002 to 2012. Lawani in Ibrahim (1993) reiterate the significance of collaboration to include the revelation of the quality of paper, arguing that other authors too support that papers by many authors tend to be more qualitative than those authored by single authors and that team approach is the preferred research strategy of many organizations. Garfield (1979) affirmed this by stating that, team made up of competent scientists derive tremendous benefits from collaboration. Similarly, Gilvary and Thrig (1959) argued that for the planning and directing of scientific research, it is important to determine the elusive factors that enter in research productivity; adopting collaboration as a factor is a very significant factor.

Therefore to be able to analyse the nature of collaboration obtainable in the units of the complex, a scoring measure that comprise of four collaboration regimes were developed and adopted. The nature and frequency scores per unit of the complex are presented in Table 4.4 and Figure 3.

Table 4.4: Nature of collaboration

Nature of collaboration	Units of the complex						Total	% scored
	DAC	FOA	IAR	NAERLS	NAPRI	VET		
With members of the same unit	14	154	131	32	30	165	**526**	**54.96**
With members from other units of the complex	4	81	35	12	23	35	**190**	**19.85**
With members outside the complex	11	62	55	6	7	27	**168**	**17.56**
With members outside Nigeria (international)	3	12	22	4	3	29	**73**	**7.63**
Total	32	302	243	54	63	256	**957**	**100**

Fig. 3: Distribution of the different types of collaboration existing among faculty members



From the Table 4.4 and Figure 3,526(54.96%) of the faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria engage in collaboration within the same unit. This is closely followed by collaboration with others from outside the complex with 168(17.56%). Although the analysis indicate high collaboration, most (716, 72.52%) of the collaborations remain internal. Zaki (2011) attribute collaboration within the same unit to two factors, the first being interdisciplinary and mutual relationship that easily exist among and between faculty members, while the second as a way to avoid scrutiny and the practice of gift authorship.

Furthermore, the analysis of the data presented above revealed that VET members collaborated most (29, 39.72%) with authors outside Nigeria (international), which was closely followed by IAR with 22(30.14%). The high nature of collaboration among the faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria is as reported by Brodkey (1987); Kassierer and Angel (1995) that a good indicator of consistencies, adjusted nature and structure of scientific communication practices. It is also acceptance that presently authorship is a collective responsibility.

Therefore, making collaboration a very significant index of research productivity measure. Accordingly the extent of collaboration was measured using a simple indicator called collaboration coefficient which is the ratio of the number of collaborative research papers during a certain period of time. The value of collaboration is between 0 and 1, with value of 1 or closer to 1 indicating a positive or high collaboration while a value far below 1 indicates negative or low collaboration. The formula given by Subramanya (1983) was adopted and expressed as:

$$C = \frac{Nm}{Nm + Ns}$$

Where

C = Degree of collaboration

Nm = Number of multi authored works

Ns = Number of single authored works

To determine the degree of collaboration of faculty members of the Agriculture and Veterinary complex of Ahmadu Bello University, Zaria, the number of single authored and multi-authored publications were calculated and applied to the formula expressed above. The values were extracted from Table 4.3 on authorship patterns, which showed number of multi authored works (957), and number of single authored works (180). Therefore, collaboration coefficient of the faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria is:

$$C = \frac{957}{957 + 180} = 0.8417$$

Ibrahim (1993) reported that a value of 1 or closer to 1 indicates positive or high collaboration while a value below indicates negative or low collaboration. From the above result it suffice to say that a positive or high collaboration exist in the complex. This result agrees with Savanur and Srikanth (2010) who reported that whenever the number of multiple authored papers surpasses single authored papers, it is intuitively a statement of fact that collaboration is maximal.

4.3.4 Research Output Spread Among the Six Units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria From 2002 - 2012

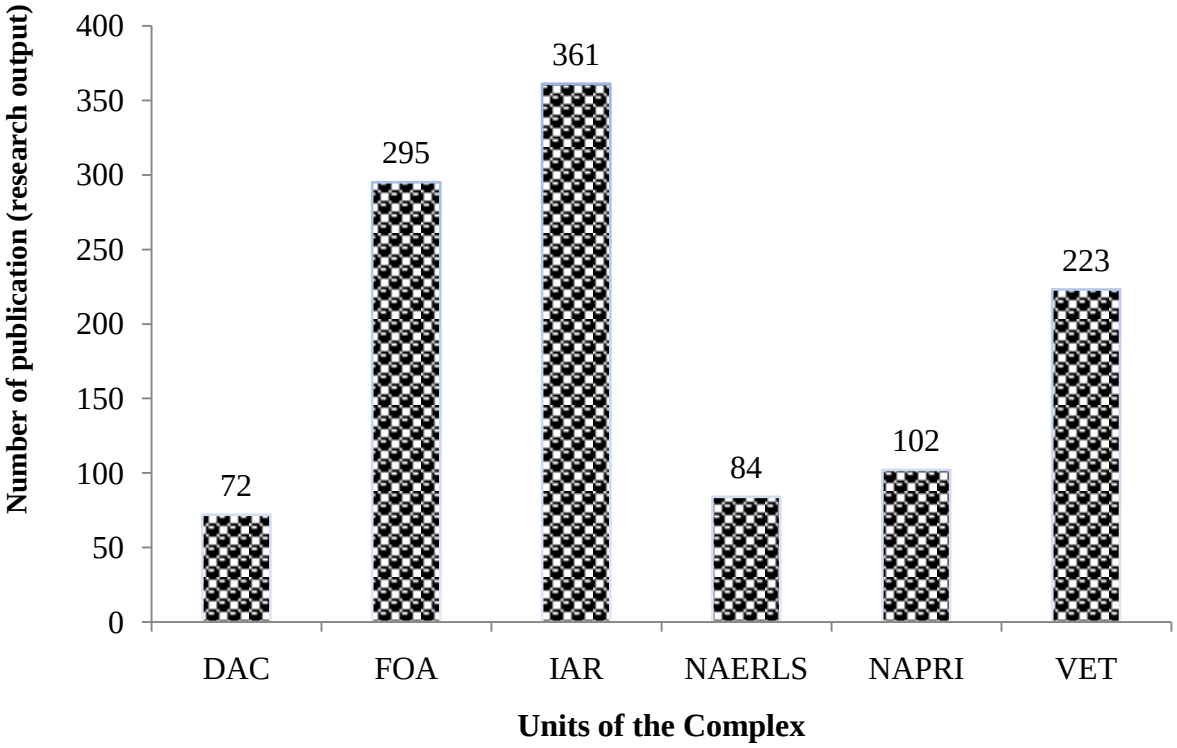
A research question was raised in order to investigate the research output spread among the six units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria by year within the eleven years covered by the study, i.e. from 2002 – 2012. The idea is to determine the most productive year for each unit. This is in line with Ibrahim and Abubakar's (2001) study which who reported that quantitative representation of data show the nature and volume of information traffic. The analysis is as presented in Table 4.5 and Figure 4.

Table 4.5: Distribution and percentage score of the research output of the units of the Agriculture and Veterinary complex of Ahmadu Bello University, Zaria from 2002 – 2012.

Year	Units of the complex						Total	% score
	DAC	FOA	IAR	NAERLS	NAPRI	VET		
2002	4	32	51	6	8	21	122	10.73
2003	2	22	32	14	6	17	93	8.18
2004	3	31	52	13	15	16	130	11.43
2005	4	38	32	18	10	17	119	10.47
2006	4	45	48	5	26	31	159	13.98
2007	11	30	31	11	17	20	122	10.73
2008	3	35	30	4	8	22	102	8.97
2009	9	17	33	2	4	38	103	9.06
2010	12	17	15	10	4	15	76	6.68
2011	10	11	19	1	4	11	56	4.93
2012	5	17	18	0	0	15	55	4.84
Total	**72**	**295**	**361**	**84**	**102**	**223**	1137	100

Key: DAC = Division of Agricultural Colleges; FOA = Faculty of Agriculture;
IAR = Institute for Agricultural Research; NAPRI = National Animal Production and Research Institute;
NAERLS = National Agricultural Extension and Research Liaison Services;
VET = The Faculty of Veterinary Medicine and Teaching Hospital

Fig. 4: Frequency counts of faculty members research output per unit in Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria (2002 - 2012)



As revealed in Table 4.4 and Figure 4, the year 2006 had a total of 159 (13.98%) published research works making it the most productive year across the six units of the complex from 2002 - 2012. This thrust may be attributable to the observation that numerous members of the faculty were promoted during the period. It is sad to note that since 2006, the productivity of each of the unit has gone down. In terms of productivity by units, the research discovered that IAR has the highest scores of 361 (31.75%) research output, closely followed by FOA with 295 (25.95%) output. The least unit with the lowest research output was DAC with 72(6.33%).

4.4 Test of Hypothesis

The hypothesis is stated below:

H_o: Research output of faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 – 2012 does not conform to Lotka's Law of Productivity.

The test of hypothesis is presented in Table 4.6.

Table 4.6: Chi-square test of observed and expected distribution of faculty members research output patterns

Number of authors	Units of the complex						**Total**
	DAC	FOA	IAR	NAERLS	NAPRI	VET	
One	10	43	87	19	8	13	**180**
	(15.51)	(39.58)	(54.93)	(17.41)	(17.41)	(34.83)	
Two	23	31	48	21	18	17	**158**
	(13.62)	(34.74)	(48.22)	(15.56)	(15.29)	(30.57)	
Three	22	69	57	32	23	56	**259**
	(22.32)	(56.95)	(79.04)	(25.51)	(25.06)	(50.11)	
Four	28	58	90	18	29	73	**296**
	(25.51)	(65.08)	(90.34)	(29.16)	(28.64)	(57.27)	
Five and above	15	49	65	22	32	61	**244**
	(21.03)	(53.65)	(74.47)	(24.04)	(23.61)	(47.21)	
Total	98	250	347	112	110	220	**1137**

Chi-square = 86.446, DF = 20, P-value = 0.000

Key: DAC = Division of Agricultural Colleges; FOA = Faculty of Agriculture;
IAR = Institute for Agricultural Research; NAPRI = National Animal Production and Research Institute;
NAERLS = National Agricultural Extension and Research Liaison Services;
VET = The Faculty of Veterinary Medicine and Teaching Hospital; Df = Degree of freedom
Expected counts are those in prentices, the observe counts are not.

From the results obtained in Table 4.6, there is significant difference between the number of single authors (180) with those of multiple authored research output (957). According to Lotka's law of productivity, of all contributors in a given subject, about 60% publish only one article with only 6% contributors in a subject area publish more than ten contributions. This contradicts whatwas obtainable in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria where research outputs by multiple authorships supersede and dominated.This implies that the null hypothesis is therefore rejected anda strong indication that there is no association between the two variables (single contributors against multiple contributors) being compared. The hypothesis test has been able to ascertain the number of contributors from the large number of authors and their diversifications.

REFERENCES

Ahmad, S., Jan, S.U. & Khan, F. (2012). Lotka's Law of Scientific Productivity: Theory and Application. *PUTAJ Humanities and Social Sciences,* 127 – 134.

Brodkey, L. (1987). *Academic Writing as Social Practice*. Philadelphia: Temple University Press.

Edge, P., Martin, F., Rudgard, S. & Thomas, N.M. (2012). Research Attitudes and Behaviour Towards the 'Openness' of Research Outputs in Agriculture and Related Fields. Paper Prepared for Coherence in Information for Agricultural Research for Development (CIARD), 18p.

Erlen, J.A., Simiroff, L.A., Sereika, S.M. & Sutton, L.B. (1997). Multiple Authorship: Issues and Recommendations. *Journal of Professional Nursing* 13(4): 262 – 270.

Fagbola, B.O. & Adejoro, M.A. (2012). Citation Pattern of the Nigerian Journal of Horticultural Science from 1990 – 2005. *Library Philosophy and Practice (e-journal)* Paper 715. Available @ http:digitalcommons.unl.edu/Libphilprac/715.

Ibrahim, U. (1993). Collaboration Among Authors of Entomological Research Literature in Nigeria. *Library Scientist* 17:55 – 69.

Ibrahim, U. & Abubakar, T. (2001). An Index to, and Characteristics of Articles Published in the Journal of Library Focus: 1983 – 1999. *Library Focus* 19: 58 – 65.

Jacobs, D. (2001). A Bibliometric Study of the Publications Patterns of Scientists in South Africa 1992 – 96, with Particular Reference to Status and Funding. *Information Research,* 6(3). Available at: http://InformatR.net/6-2/paper104.html. Accessed 27/3/2014.

Kassierer, J.P. & Angel, M. (1995). On Authorship and Acknowledgements. *New England Journal of Medicine* 325: 1510 - 1512.

Mengxiong, L. (1993). Progress in Documentation. The Complexities of Citation Practice: A Review of Citation Studies. *Journal of Documentation* 49:390.

Subramanyan, K. (1983). Bibliometric Studies of Research Collaboration: A Review. *Journal of Information Science* 6(1): 33 – 38.

Sudhier-Pillai, K.G. (2013). Lotka's Law and Pattern of Author Productivity in the Area of Physics Research. *DESIDOC Journal of Library & Information Technology* 33(6): 457 -464.

Thanuskodi, S. (2010). Journal of Social Sciences: A Bibliometric Study. *Journal of Social Sciences* 24(2): 77 -80.

Wardikar, V.G. & Gudadhe, V.P.C. (2013). Application of Bradford's Law of Scattering to the Literature of Library and Information Science: A Study of Doctoral Theses Citations Submitted to the Universities of Maharashtra, India. *Library Philosophy and Practice (e-journal).* Paper 1054. Retrieved February 28, 2014 from http://digitalcommons.unl.edu/libphilprac/1054.

Zaki, S.A. (2011). Gift Authorship – A Cause of Concern. *Lung India* 28(3): 232 – 233.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter presents the summaries of the study and major findings. It also presented the conclusion of the study as well as recommendation.

5.2 Summary of the Study

The research output of faculty members of the Ahmadu Bello University Agriculture and Veterinary Complex from 2002 – 2012 were investigated using bibliometrics analysis. Therefore, in order to achieve the objectives of the study, four research questions and one hypothesis were formulated. Among the research questions formulated were: what are the research output formats of faculty members of the Agriculture and Veterinary Complex, what is the authorship pattern of faculty members of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria, what is the nature of collaboration among the faculty members in research output in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria, and what is the research output spread among the six units of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria, while the hypothesis set out is that research output of faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria from 2002 – 2012 does not conformed to Lotka's Law of Productivity.

The populations of the study were the faculty members of the six units that constituted the University Agriculture and Veterinary Complex. The subjects comprised of

33 (86.84%), professors and associate professors that attained the positions from 2002 - 2012.

Data collection was done using direct counting method. The data gathered were computed into Excel (spread sheet) to generate tables and charts. The results were presented descriptively using frequency counts, percentages and totals. The test of hypothesis was done using a non-parametric Chi-square inferential statistics to ascertain the result conformity to Lotka's Law of Productivity.

5.3 Summary of Major Findings

The following are summary of major findings of the study:

1. Five categories of research output formats were found to be used by faculty members of Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria to showcase their research works. These research output formats comprised of journals, books/chapters in books, seminars/ conference proceedings, technical report/workshop/training and bulletins/ guides/magazine. The most used research output formats was journals.
2. Authorship pattern in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria was dominated by multiple authorship.
3. Although the degree of collaboration coefficient indicated high collaboration, the findings revealed that collaboration was more within the same unit, compared with members from other units as well as collaboration outside the complex within Nigeria and outside Nigeria. This implies that collaboration was mostly internal.

4. The year 2006 was the most productive across the units of the complex whereas IAR was the most productive unit.
5. It was found that the hypothesis tested rejects the null hypothesis implying that faculty members research output does not conform to Lotka's Law of Productivity.

5.4 Conclusion

The use of bibliometric analysis to investigate authorship patterns of the research output of faculty members in the agriculture and veterinary complex of Ahmadu Bello University, Zaria provided understanding and shows the distribution, contributions of the faculty members as authors and the units they represent as they engage in research.

The study revealed that faculty members publish their research output in numerous formats that comprise journals, books, chapters in books, seminar, conference, technical report, bulletins and others. Faculty members authorship pattern ranged from single authored to multiple authorship. In the complex, multiple authorship dominated and most preferred; this consist of two and above number of authors per research output. The collaboration was mostly internal.

5.5 Recommendations

The following recommendations were made based on the findings and conclusion reached in the study:

1. Research output formats accepted for staff promotions influences the choice for publication. It is imperative to consider the plight of the agricultural stakeholders which include literates as well as illiterates, therefore, research output formats should

be expanded to include posters, translations and other formats capable of disseminating topical information to numerous stakeholders beyond the academic setting.

2. Joint authorship should be sustained but must be encouraged to be based on areas of specialization so that contributions made to research output can reflect these areas; bring to bear experiences and expertise to resolve identified threats to agriculture.
3. While internal nature of collaboration among faculty members of the same unit dominated, it is recommended that the complex can gain external collaboration by engaging through proposals to the Consultative Groups of Institute for AgriculturalResearch (CGIAR), a conglomerate of World Bank, Food and Agriculture Organization, African Development Bank, International Monetary Funds and the platform on which agricultural institutes across the worldstrive and engage researchers to share and publish outcomes of their works.
4. To improve on the spread and contributions of research output from the units of the complex, it is recommended that the complex should periodically acknowledge performance through awards and recognition for hard workto serve as morale booster to work more.

5.6 Suggestion for Further Study

1. This study focused on the Faculty Members of Agriculture and Veterinary Complex in Ahmadu Bello University, Zaria. There is need to replicate this study in other complexes of the University to also ascertain their levels of research output.
2. A study could also be carried out to investigate the applications of Bradford, Zipfs and other laws of bibliometrics on the faculty members research activities and output.

BIBLIOGRAPHY

Abalu, G.I. (2001). Policy Issues in Maize Research and Development in Sub-Saharan Africa in the Next Millennium. In: Badu-Apraku, B., Fakorede, M.A.B., Ouedraogo, M. and Carsky, R.J. (editors). Impact, Challenges and Prospects of maize research and development in West and Central Africa. *Proceedings of a Regional Maize Workshop* 4 – 7 May, 1999, pp.3-30, WECAMAN/IITA, Benin Republic.

ABU MIS (Ahmadu Bello University Management Information Services) (2013a). Staff List of Division of Agricultural Colleges. Available at http://www.abu.edu.ng/faculty/view_staff.php?depid=&fac=Division%20of%20Agricultural%20Colleges# (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013b). Faculty of Agriculture Staff List. Available at http://www.abu.edu.ng/category/cview.php?t=a&cid=2&cnm=Agriculture (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013c). Faculty of Veterinary Medicine and Teaching Hospital Staff Strength. Available at http://www.abu.edu.ng/category/cview.php?t=a&cid=13&cnm=Veterinary%20Medicine (accessed on 25th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013d). National Animal Production Research Institute Staff list. Available at http://www.abu.edu.ng/unit/index.php?t=i&cid=20&cnm=Centres&did=135&dnm=NAPRI (accessed on 26th May, 2013).

ABU MIS (Ahmadu Bello University Management Information Services) (2013). List of Academic Staff. 20p. Directorate, Management Information Systems.

Ado, S.G. (2006). Available Postgraduate Research Opportunities at the Institute for Agricultural Research, Samaru. ABU Postgraduate School Lecture Series. pp.2.

Afolabi, M. (1993). Introduction to Research Method for Writing Project and Thesis, Zaria, Alpha Publishers.

Ahmad, S., Jan, S.U. & Khan, F. (2012). Lotka's Law of Scientific Productivity: Theory and Application. *PUTAJ Humanities and Social Sciences,* 127 – 134.

Aliyu, M. (2011). Author Productivity and Collaboration Among Academic Scientists in Modibbo Adama University of Technology, Yola. *The Information Manager* 11(1&2): 32 – 35.

Anonymous (1987). A History of Ahmadu Bello University, Zaria 1962-1987. ABU Press Ltd., pp. 172-174.

Arya, C. & Sharma, S. (2011). Authorship Trends and Collaborative Research in Veterinary Sciences: A Bibliometric Study. Chinese Librarianship: An International Electronic Journal, 34. URL: http://www.iclc.us/cliej/cl34AS.pdf

Barthes, R. (2001). "The Death of the Author". *The Norton Anthology of Theory and Criticism*. Ed. Vincent B. Leitch. New York: W.W. Norton & Co.

Bird, J.E. & Bird, M.D. (1999). Do Peer-Reviewed Journal Papers Results from Meeting Abstracts of the Biennial Conference on the Biology of Marine Mammals? *Scientometrics* 46(2): 295.

Bland, C.J., Center, B., Finstad, D.A., Risbey, K. & Staples, J.G. (2005). A Theoretical, Practical, Predictive Model of Faculty and Department Research Productivity. *Academic Medicine* 80(3):225 – 237.

Bland, C.J., Seaquist, E., Pacala, J.T., Center, B. & Finstad, D. (2002). One School's Strategy to Assess and Improve the Vitality of Its Faculty. *Academic Medicine* 77:368 – 376.

Bornmann, L., Mutz, R., Neuhaus, C. & Daniel, H.D. (2008). Citation Counts for Research Evaluation: Standards of Good Practice for Analyzing Bibliometric Data and Presenting and Interpreting Results. *Ethics in Science and Environmental Politics* 8: 93 – 102.

Brocato, J.J. (2001). The Research Productivity of Family Medicine Department Faculty: A National Study Dissertation, Michigan State University.

Brodkey, L. (1987). *Academic Writing as Social Practice*. Philadelphia: Temple University Press.

Bukar, S., Adamu, A. and Bakshi, J.S (eds.) (1997). Nigeria, National Agricultural Strategy Plan: 1990-2010. Ibadan, African books Ltd., pp.71-116.

Castillo, J.J. (2009). Stratified Sampling Method. Retrieved March 2012 from Experiment Resources: http://www.experiment-resources.com/stratified-sampling.html

Coote, C., Tomlins, K., Massingue, J. Okwadi, J. & Westby, A. (2011). Understanding Consumer Decision Making to Assist Sustainable Marketing of Vitamin A-Rich Sweetpotato in Mozambique and Uganda. 2020 Conference Note 2. Washington, D.C.: International Food Policy Research Institute.

Creswell, J.W. (1985). Faculty Research Performance: Lessons From the Sciences and Social Sciences. Washington, DC: Association for the Study of Higher Education.

Creswell, J.W. (1986). *Measuring Faculty Research Performance*. San Francisco Jossey-Bass. 120p.

Cronin, B. (2001). Hyper-Authorship: A Post Modern Perversion or Evidence of a Structural Shift in Scholarly Communication. *Journal of American Society for Information Science* 52(7): 558 – 569.

Dundar, H. & Lewis, D.R. (1998). Determinants of Research Productivity in Higher Education Research. *Higher Education* 39:607 – 631.

Edge, P., Martin, F., Rudgard, S. & Thomas, N.M. (2012). Research Attitudes and Behaviour Towards the 'Openness' of Research Outputs in Agriculture and Related Fields. Paper Prepared for Coherence in Information for Agricultural Research for Development (CIARD), 18p.

Egghe, L. (2005). Relations Between the Continuous and the Discrete Lotka Power Function. *Journal of the American Society for Information Science and Technology*, 56(7): 1-13.

Egwunyenga, E.J. (2008). Dystrophies and Associated Crises in Research and Academic Publications in Nigerian Universities. *Anthropologists* 10(4):245 – 250.

Ekoja, I.I. (2003). Farmers' Access to Agricultural Information in Nigeria. *Bulletin of the American Society for Information Science and Technology*, pp. 21 – 23, August/September.

Erlen, J.A., Simiroff, L.A., Sereika, S.M. and Sutton, L.B. (1997). Multiple Authorship: Issues and Recommendations. *Journal of Professional Nursing* 13(4): 262 – 270.

Fagbola, B.O. & Adejoro, M.A. (2012). Citation Pattern of the Nigerian Journal of Horticultural Science from 1990 – 2005. *Library Philosophy and Practice (e-journal)* Paper 715. Available @ http:digitalcommons.unl.edu/Libphilprac/715.

Fairweather, J.S. (1999). The highly productive faculty member: Confronting the mythologies of faculty work. In: W.G. Tierney, ed. Faculty productivity: Facts, fictions, and issues (New York: Falmer Press), 55-98.

FAO (Food and Agriculture Organization) (1997). Agriculture, food and nutrition for Africa: A resource book for teachers of agriculture. 412p. Rome.

Finkelstein, M.J. (1984). The American Academic Profession: A Synthesis of Social Scientific Inquiry Since World War II. Columbus: Ohio State University Press.

Gideon, E.C. (2008). Issues and Challenges to the Development of Open Access Institutional Repositories in Academic and Research Institutions in Nigeria. A

Research Paper Prepared for the International Development Research Centre (IDRC), Ottawa, Canada. 64p.

Girard, A., Self, J., McAuliffe, C. & Oludea, O. (2012). The Effects of Household Food Production Strategies on the Health and Nutrition Outcomes of Women and Young Children: A Systematic Review. *Paediatric and Perinatatal Epidemiology* 26(1): 205 – 222.

Griffith University (2013). Research Plan 2013 – 2017. Available online at http://www.griffith.edu.au/__data/assets/pdf_file/0008/535922/20431_13-RESEARCH-2013-2017FINALweb. Accessed 16th May, 2013, 26p.

Gu, Y. (2004). Information Management or Knowledge Management? An Informetric View of Scientometrics. *The Dynamics of Academia* 61: 285-299.

Harande, Y.I. (2001). Author Productivity and Collaboration: An Investigation of the Relationship Using the Literature of Technology. *Libris* Vol., 51: 124 – 127.

Hawkes, C., Turner, R. & Waage, J. (2012). Current and Planned Research on Agriculture for Improved Nutrition: A Mapping and a Gap Analaysis. A Report for DFID in Collaboration with Leverhulme Centre for Integrative Research on Agriculture and Health, University of Aberdeen and Centre for Sustainable International Development, 48p.

Hertzel, D.H. (1987). Bibliometrics: History of the Development of Ideas. In: *Encyclopedia of Library and Information Science*, New York: Marcel Decker, 42: 169 – 173.

IAR (Institute for Agricultural Research) (1996). "This is the Institute for Agricultural Research (IAR)", Third Edition. Fadiji, T.O., Gefu, T.T. and Adeniji, O.B. (eds.). Publications and Information Unit, IAR, Samaru – Zaria.

IAR (Institute for Agricultural Research) (2012). Institute for Agricultural Research Staff and Phone Directory. A Publication of the Office of the Secretary, IAR, Samaru – Zaria.

Ibrahim, U. (1997/98). Quantitative Analysis of Current Scientific Research and Productivity in IAR and NAPRI, Zaria, Nigeria. *Library Focus* 15& 16: 36 – 42.

Ibrahim, U. (2013). Techniques for Writing and Presentation of Thesis/Dissertation: A Companion Guide for Postgraduate Students in Nigeria University System.- Zaria, ABUP, 95p.

Ibrahim, U. & Abubakar, T. (2001). An Index to, and Characteristics of Articles Published in the Journal of Library Focus: 1983 – 1999. *Library Focus* 19: 58 – 65.

Jacobs, D. (2001). A Bibliometric Study of the Publications Patterns of Scientists in South Africa 1992 – 96, with Particular Reference to Status and Funding. *Information Research*, 6(3). Available at: http://InformatR.net/6-2/paper104.html. Accessed 27/3/2014.

Javed, M. & Shah, S.S. (2008). Rawal Medical Journal: An Analysis of Citation Pattern. *Rawal Medical Journal* 33(2): 254 – 257.

Kassierer, J.P. & Angel, M. (1995). On Authorship and Acknowledgements. *New England Journal of Medicine* 325: 1510 - 1512.

Kernan, A. (1991). The Death of Literature. *The Georgia Review* 45(1): 186 – 191.

Le Boeuf, P. (2006). "... That struts and frets his hour upon the stage and then is heard no more ...": the elements that should be accounted for in a conceptual model for performing arts and the information relating to their archives . *Paper presented at the workshop "De la conception à la survie: comment documenter et conserver les productions du spectacle multimédia ?" Paris, Centre de documentation de la musique contemporaine, as part of the "Rencontres itinérantes" "Quelles noces de la musique et de l'image ?"*, 13 January,10p.

Ligthelm, A.A. & Koekemoer, E.M. (2009). Academic publishing: Lessons Learnt From the Southern Africa Business Review. *Southern Africa Business Review* 13(3): 28 – 50.

McBurney, M.K. & Novak, P.L. (2002). "What Is Bibliometrics and Why Should You Care?" In: *Reflections on Communication: Proceedings of IEEE International Professional Communication Conference, Portland, Oregon, September 17-20,* pp. 108-114. IEEE, Piscataway, NJ.

McCann, L. (2013). Academic Use of Electronic Publications in Social Sciences and Humanities and Changing Roles for Libraries. Association of College and Research Libraries.

Mengxiong, L. (1993). Progress in Documentation. The Complexities of Citation Practice: A Review of Citation Studies. *Journal of Documentation* 49:390.

Middaugh, M.F. (2001). Understanding Faculty Productivity: Standards and Benchmarks for Colleges and Universities.(San Francisco: Jossey-Bass). 160p.

Millar, J. & Senkar, J. (2000). International Approaches to Research Policy and Funding: University Research Policy in Different National Contexts; University of Sussex: SPRU Science and Technology Policy Research. 46p.

NAERLS (National Agricultural Extension and Research Liaison Services) (2011). NAERLS at a Glance. National Agricultural Extension and Research Liaison Services, Federal Ministry of Agriculture and Rural Development, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. NAERLS Printing press.

Newman, M.E.J. (2004). Coauthorship Networks and Patterns of Scientific Collaboration. *PNAS* 101(1):5200 – 5205. Available at www.pnas.org/cgi/doi 10.1073 pnas.0307545100, accessed on 14/07/2014.

Nigerian Copyright Act (2004). Cap 28 Laws of the Federation of Nigeria. 33p. Available at www.copyright.gov.ng/index.php/.../nigerian-copyright-act-lfn-2004 accessed 14/07/2014.

Nwagu, W.E. (2007). Patterns of Authorship in the Biomedical Literature of Nigeria. *LIBRES* 17(1) March. URL: http://Libres.curtin.edu.au/

Okafor, V.N. (2011). Comparative Analysis of Research Output of Federal Universities in Southern Nigeria. *Library Philosophy and Practice* Available: http/libr.unl.edu/LPP/

Oloruntoba, A. & Ajayi, M.T. (2006). Gender and Research Attainment in Nigerian Agricultural Universities. JHEA/RESA 4(2):83 – 98.

Olufalaji, A. (2009). The Role of Research in Agricultural Development. Paper Presented at the Agriculture exhibition. Theme: Agriculture – The new frontier. Organized by Enhancing Financial Innovation and Access (RFInA) held at NIHORT, Ibadan. 29 – 30th March, 18p.

Pendlebury, D.A. (2009). *Whitepaper: Using Bibliometrics: A Guide to Evaluating Research Performance with Citation Data*. Philadelphia: Thomson Reuters.

Polanco, X. (1995). Infométrie et ingénierie de la connaissance, in J.-M. Noyer (Ed.), Les sciences de l'information bibliométrie scientométrie infométrie, Rennes, Presses Universitaires de Rennes

Qui, L. (1990). An Empirical Examination of the Existing Model for Bradford's Law. *Inf. Proc. Manage.*, 26(5): 655 – 672.

Rabiu, S.A. (2012). Establishment of DAC's Academic Activities and its Roles in the Ahmadu Bello University and the Nation At Large. Paper presented in commemoration of ABU @ 50 Celebration held in NAERLS Conference Hall, 9p.

Ramirez, Y.W. & Nambband, D.A. (2004). Measuring Knowledge Worker Productivity: A Taxonomy. *Journal of Intellectual Capital* 5(5):602 – 628.

Sen, B.K., Taib, C.A. & Hassan, M.F. (1996). Library and Information Science Literature and Lotka's Law. *Malaysian Journal of Library and Information Science,*1(2): 89 – 93.

Solu, T., Kendagor, R., Kosgei, D., Tuitoek, D. & Chelangat, S. (2012). Factors Affecting Research Productivity in Public Universities of Kenya: The Case of Moi University, Edoret. *Journal of Emerging Trends in Economics and Management Sciences* (JETEMS) 3(5): 475 – 484.

Subramanyan, K. (1983). Bibliometric Studies of Research Collaboration: A Review. *Journal of Information Science* 6(1): 33 – 38.

Subtramanyam, F. (2007). Bibliometric Studies of Research Collaboration: A Review. *Journal of Information Science* 5:36.

Sudhier, K.G. (2010). Application of Bradford's Law of Scattering to the Physics Literature: A Study of Doctoral Theses Citations at the Indian Institute of Science. *DESIDOC Journal of Library & Information Technology* 30(2): 3 -14.

Sudhier-Pillai, K.G. (2013). Lotka's Law and Pattern of Author Productivity in the Area of Physics Research. *DESIDOC Journal of Library & Information Technology* 33(6): 457 -464.

Sun, J., Wang, M.-H., & Ho, Y.-S. (2012). A Historical Review and Bibliometric Analysis of Research on Estuary Pollution. *Marine Pollution Bulletin*, 64(1):13–21.

Teodorescu, D. (2000). Correlates of Faculty Publications Productivity: A Cross-National Analysis. *Higher Education* 39:201 – 222.

Thanuskodi, S. (2010). Journal of Social Sciences: A Bibliometric Study. *Journal of Social Sciences* 24(2): 77 -80.

University of Auckland (2012). Definition and Categories of Research Outputs. Available online at https://policies.auckland.ac.nz/policy-display-register/authorship-guidelines.pdf. Accessed 16th May, 2013. 4p.

Van Raan, A.F.J. & Van Leeuwen, T.N. (2002). Assessment of the Scientific Basis of Interdisciplinary, Applied Research Application of Bibliometric Methods in Nutrition and Food Research. *Research Policy* 31:611 – 632.

Van Raan, A.F.J. (2001). Competition Among Scientist for Publication Status: Towards a Model of Scientific Publication and Citation Distribution. *Scientometrics* 51(1):347 - 357.

Wang, H-C., Pang, C-Y & Huang, J-Y. (2012). Analysis of Academic Research Performance from Publications in the Field of Computer Science. *Malayan Journal of Library & Information Science* 17(2): 51 – 70, August.

Wardikar, V.G. & Gudadhe, V.P.C. (2013). Application of Bradford's Law of Scattering to the Literature of Library and Information Science: A Study of Doctoral Theses Citations Submitted to the Universities of Maharashtra, India. *Library Philosophy and*

Practice (e-journal). Paper 1054. Retrieved February 28, 2014 from http://digitalcommons.unl.edu/libphilprac/1054.

Weiss, A.P. (2007). Measuring the Impact of Medical Research: Moving from Outputs to Outcomes. *American Journal of Psychiatry* Feb;164(2): 206–14.

Wilkinson, E.A. (1972). Ambiguity of Bradford's Law. *Journal Documentation*, 28: 122 – 130.

Xiao, H. & Smith, S.L.J. (2006). The Making of Tourism Research: Insights from a Social Sciences Journal. *Annals of Tourism Research* 33(2): 490 – 507.

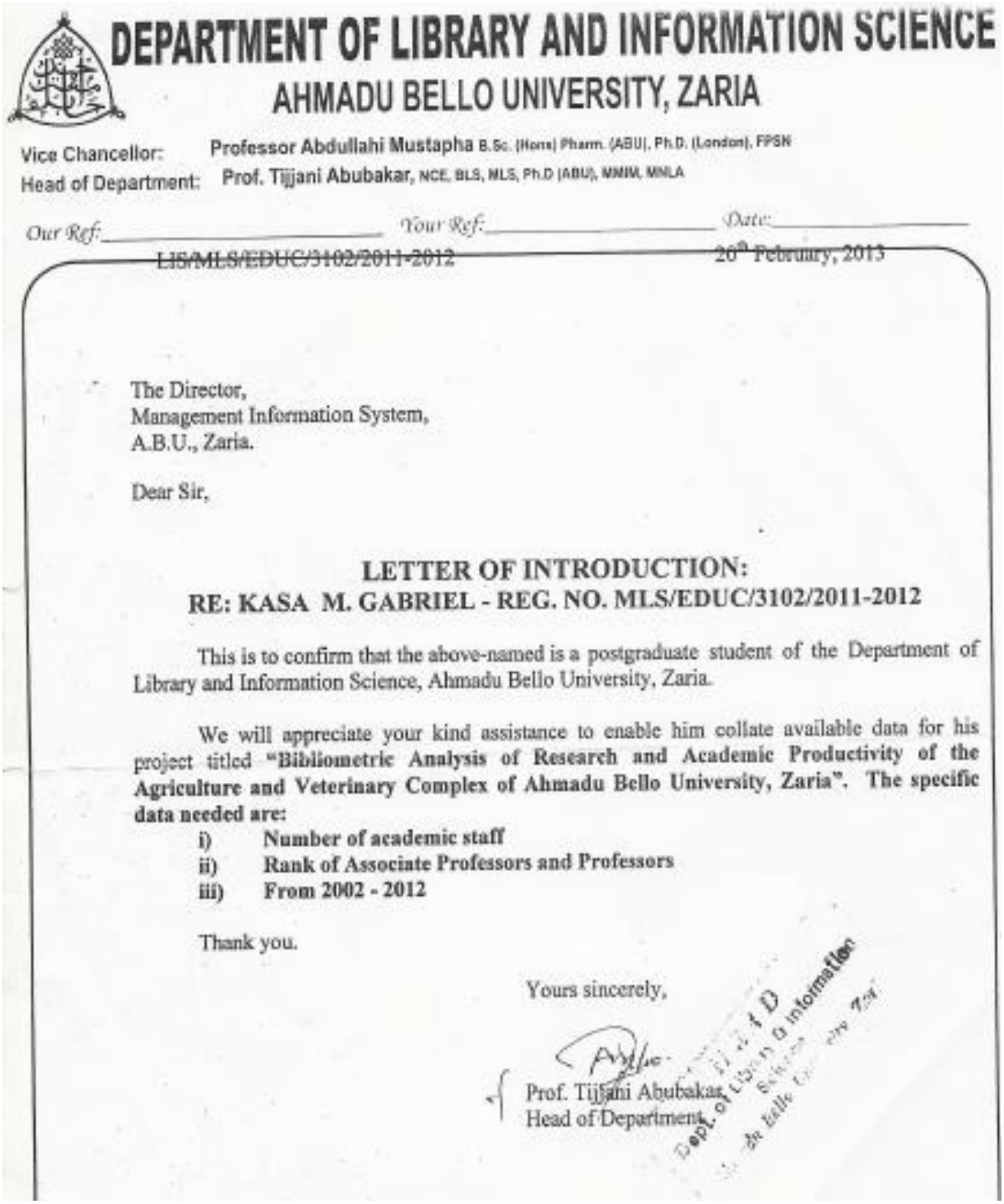
Zaki, S.A. (2011). Gift Authorship – A Cause of Concern. *Lung India* 28(3): 232 – 233.

Zang, L. (2007). Citation Analysis for Collection Development: A Study of International Relation Journal Literature. *Library Collection, Acquisition and Technical Services* 31: 195 – 207.

Ziegler, B.E. (2009). Methods for Bibliometric Analysis of Research: Renewable Energy Case Study. Master of Engineering in Electrical Engineering and Computer Science Submitted to the Department of Electrical Engineer and Computer Science, Massachusetts Institute of Technology.

Appendix I

Letter soliciting for number of academic staff in the Agriculture and Veterinary Complex, those promoted associate professor and professors during 2002 to 2012.



DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE
AHMADU BELLO UNIVERSITY, ZARIA

Vice Chancellor: Professor Abdullahi Mustapha B.Sc. (Hons) Pharm. (ABU), Ph.D. (London), FPSN
Head of Department: Prof. Tijjani Abubakar, NCE, BLS, MLS, Ph.D (ABU), MNIM, MNLA

Our Ref: LIS/MLS/EDUC/3102/2011-2012 Your Ref: Date: 20th February, 2013

The Director,
Management Information System,
A.B.U., Zaria.

Dear Sir,

LETTER OF INTRODUCTION:
RE: KASA M. GABRIEL - REG. NO. MLS/EDUC/3102/2011-2012

This is to confirm that the above-named is a postgraduate student of the Department of Library and Information Science, Ahmadu Bello University, Zaria.

We will appreciate your kind assistance to enable him collate available data for his project titled **"Bibliometric Analysis of Research and Academic Productivity of the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria". The specific data needed are:**

i) **Number of academic staff**
ii) **Rank of Associate Professors and Professors**
iii) **From 2002 - 2012**

Thank you.

Yours sincerely,

Prof. Tijjani Abubakar
Head of Department

Appendix II

Introductory letter To Whom It May Concern.

DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

Vice-Chancellor: **Professor Abdullahi Mustapha,** *B.Sc. (Hons) Pharm. (A.B.U), Ph.D. (London), FPSN*
Head of Department: **Abdullahi Ibrahim Musa,** *Ph.D (Emporia, USA), MBA, MLS, PGDPA, PGDM, BA (LS)*
e-mail: lis@abu.edu.ng Tel: 08174568401/09033706447

MLS/EDUC/3102/2011-2012 23rd October, 2014.

TO WHOM IT MAY CONCERN

Sir,

LETTER OF INTRODUCTION: KASA MATTHIAS GABRIEL

I write to introduce the bearer of this letter **KASA, Gabriel Matthias**, a post graduate student of this Department with Reg. No **MLS/EDUC/3102/2011-2012**. He is carrying out research title "Bibliometric Analysis of Research Output of Faculty Members in the Agriculture and Veterinary Complex of Ahmadu Bello University, Zaria".

Kindly Accord him all necessary assistance.

Thank you.

Yours Faithfully,

Muktar Ibrahim.

For: Head of Department