CHAPTER ONE

INTRODUCTION

Background to the Study

Developing and developed countries of the world recognises the importance of the agricultural sector in the growth and development of their economies. Nigeria as a developing country appreciates the important place of a vibrant agricultural sector in her economic development, especially in the areas of provision of food, as well as raw materials for industries, among others. Simply put, "the role of agriculture in the provision of food, raw materials and employment for her teeming population has made the sector critical in Nigeria's march towards economic development."[1]

As a result of the importance attached to this sector by the Nigerian government, even right from colonial times, efforts have continued to be made towards expanding and modernising agriculture, with a view to increasing productivity and enhancing food security in the country. The various governments of Nigeria have embarked on and implemented several various agricultural policies and programmes, some of which are defunct or abandoned, while others are still in place.[2] One of these agricultural policies/programmes is the establishment of specialised institutions known as "Research Institutes." The research institutes were established to carry out researches in agriculture for the purpose of socio-economic development of the country.

There is evidence to suggest that agricultural research institutes in Nigeria have, to a great extent, contributed to the growth and development of agriculture in the country. "Agricultural research institutes have immensely contributed towards agricultural production through the efforts of research scientists who researched into various areas of agriculture."[3] The agricultural research institutions first started in Nigeria during the period of colonial administration, from 1861 – 1950.

Plate 1: Front view of the National Root Crops Research Institute, Umudike

Source: *C.O Chukwuleta field survey, 2017*

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They passed through the periods of internal self-government (1951 - 1960) and continued to develop and grow during the post independence era.[4]

It is worthy of note that "there were seventeen agricultural research institutes in Nigeria,"[5] which grew out of different circumstances at different times with the objective of satisfying various needs of that time. They, along with their sub-groups will be discussed in details in the later part of the work.

The National Root Crops Research Institute (NRCRI), Umudike, started as a provincial farm of the Moor plantation.[6] Some of the research institutes in Nigeria started as regional research institutes aimed at addressing the agricultural problems of the different regions. The NRCRI, Umudike, passed through processes of historical metamorphosis as we shall see in the later part of this research. The institute was charged with the responsibility of conducting research into genetic improvement of root and tuber crops which are of utmost importance to the economic development of the country. Such crops include: cassava; yam; cocoyam; sweet potatoes; Irish potatoes; ginger; rizga; sugar beets and turmeric.[7]

The Institute started on 1st January, 1923, as an experimental provincial research farm of the Moor Plantation, Ibadan under the Nigerian Department of Agriculture.[8] As a result of regionalisation in 1955, it came under the Eastern Region Ministry of Agriculture, supervised by the Director of Agriculture, Enugu. In 1956, the Research Farm became known as the Eastern Nigeria Agricultural Research Station (ENARS), and was located on the research farm. The station was taken by the Federal Government on 1st April 1972, and renamed Federal Agricultural Research and Training Station.[9]

The station was upgraded to a Commodity Research Institute in 1975 by the Federal Military Government and was renamed the National Root Crop Research Institute (NRCRI), Umudike, on 1st April, 1976.[10] The Institute has been known and addressed by this name, and it is currently under the supervision of the Agricultural Research Council of Nigeria.

The NRCRI was established to provide necessary environment for the production, processing and marketing of value-added products from root and tuber crops for national food security; income generation; gainful employment and industrial development. It covers Abia, Imo, Anambra, Enugu, Ebonyi, Cross River, Rivers, Bayelsa and Akwa Ibom States.[11] The activities of the Institute have not been widely known to the average Nigerian, except to those around the institute and those in the agricultural sector.[12]

The present study has undertaken to examine the NRCRI, Umudike, its structure; operational activities; various impacts of the research institute on the agricultural/economic development of Nigeria; processes of disseminating research findings; as well as the challenges facing the Institute.

Statement of the Problem

Agriculture has been the main source of gainful employment from which the Nigerian nation feeds its teeming population, provide the nation's industries with local raw materials, as well as provide a reliable source of government revenue. The centrality of such a role which agriculture plays also connotes the importance of the sector which makes it one of the top government priorities.

As a result of the overall importance of the agricultural sector, agricultural research institutes were established by government. Thus, over the years, government established several agricultural research institutes, colleges and universities of agriculture aimed at promoting and improving agriculture. The Institute researched into improved farming techniques and disseminated information on better farming methods and improved crop varieties, pesticides, herbicides and fungicides.[13]

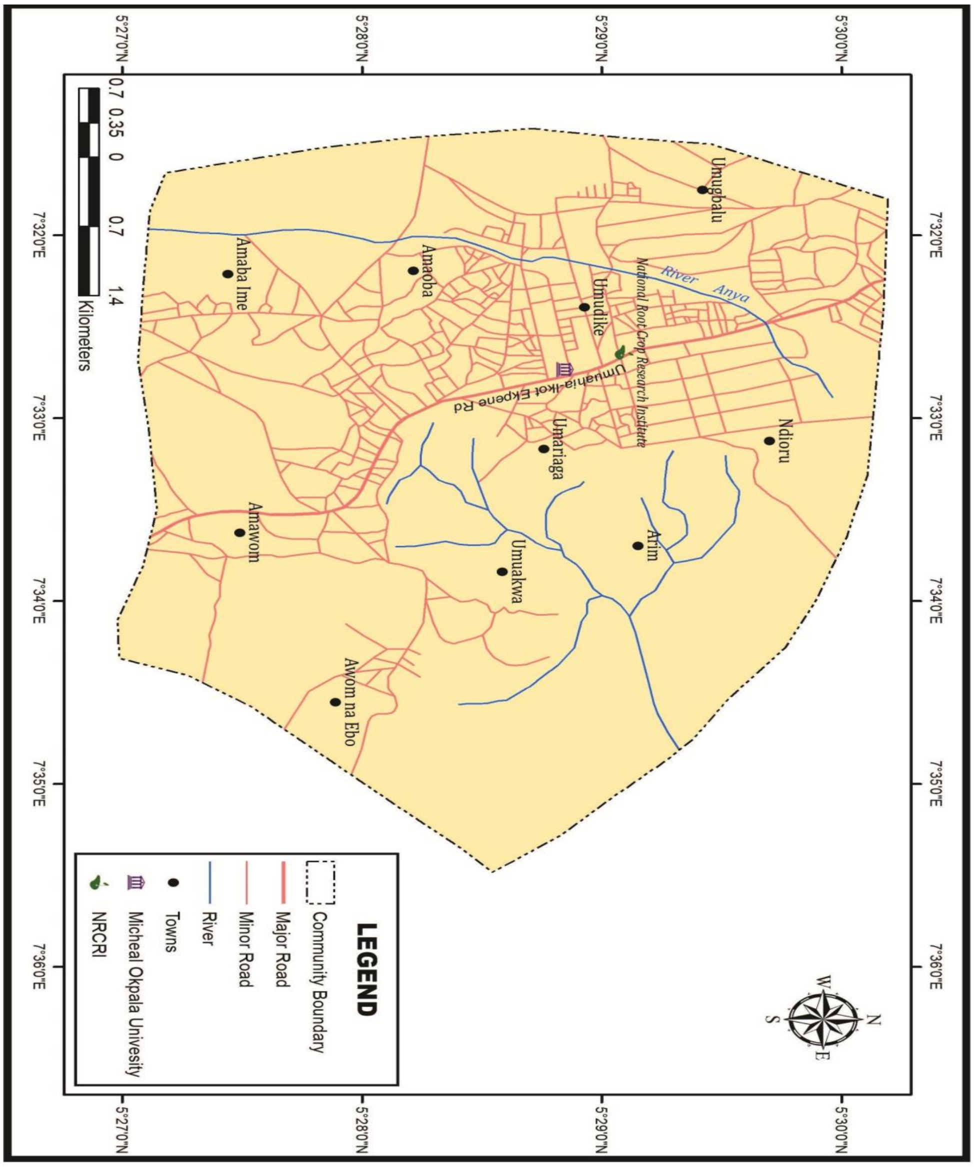
Most people are not conversant with the activities of Research Institutes and their role in agricultural development. The desire and need to review and examine the activities of the Institutes informed the decision to embark on this study.

Before now, work on the Institute has been done by policy makers, free lancers and agriculturists but none has been done by historians and at this level. This forms part of the reasearchers reason for embarking on this study.

Purpose of the Study

The purpose of this study is to reconstruct the history of the National Root Crop Research Institute, Umudike, in Abia State, with the following specific objectives: locate the origin of the NRCRI, Umudike, within the context of the general history of agricultural research institutes in Nigeria; establish an overall view of the peculiar circumstances of the growth and historical development of the Institute over the years; identify the Institute's operational activities; identify the Institute's methods of innovation dissemination; examine the impact of the Institute on the economic development of the states in its agro ecological zone; and establish the challenges confronting the Institute.

MAP OF UMUDIKE, SHOWING THE LOCATION OF NRCRI



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Significance of the Study

This study is about the National Root Crops Research Institute (NRCRI), Umudike, in Abia State, and it covers the years from 1976 up to 2014. The significance of the study lies in the fact that it will hopefully: reconstruct and locate the history of the Institute within the general context of the history of agricultural research institutes in Nigeria; provide adequate information on the Institute's operational activities; reveal the challenges faced by the institute over the years; serve as a contribution to the growing historiography of agricultural research institutes in sub-saharan Africa; serve as a reference point for agricultural research institutes in Nigeria; practically assist government through its ministries, departments and agencies in policy making towards the improvement of agricultural research institutes; enable agricultural planners to better understand and appreciate the efficacy of proper planning, adequate execution of programmes and appropriate funding and its outcome; help individual farmers, organisations, non-governmental and professional organisations to know the modus operandi of the NRCRI, Umudike, and how to utilise its activities; and finally, serve as a reference material for individuals and academic world who desire to conduct research on related topics.

Scope of the Study

This study covers a period from 1976 to 2014. A major part of the scope of this study covers the origin, structure, operational activities, methods of innovation dissemination, and problems of the National Root Crops Research Institute (NRCRI), Umudike, in Abia State. The study also dwells on the importance of the institute for the agricultural development of the agro-ecological zone it covers. Being a post-independence study, the information provided herein covers the years from 1976 to 2014.

The time-frame of 1976 and 2014 is significant, this is because the year 1976 marked a turning point in the history of the Institute. NRCRI came to be known by its present

name on 5th June, 1976, and was charged with the responsibility of total farming systems research and extension covering an agro-ecological zone that includes the states of the South-east and the South-south geo-political zones. Since then, the institute has recorded numerous breakthroughs and made tremendous impact on agricultural activities in Nigeria, despite its challenges. The study does not, however, go beyond 2014 – the year of the institute's landmark achievement in producing pro-vitamin 'A' fortified cassava improved varieties.[14]

Methodology and Sources

To achieve the stated objectives of this study, it is imperative to rely on a wide range of sources. Therefore, qualitative approach of historical research has been adopted for the study. The researcher has utilised available sources of information grouped under the primary and secondary sources. The primary sources represent interviews conducted during field trips and personal observations while the secondary sources consist of monographs, textbooks and journals. In addition, information from annual reports, newspapers, magazines and the internet considered necessary have been explored and used.

The primary reason for the adoption of oral interviews and personal observations was to clarify the areas not covered by written sources which were unclear. This method assisted in divulging divergent views on the history of the NRCRI, Umudike, its operational activities, impact and various challenges.

Conceptual Clarifications

For easy understanding of this dissertation, it is of importance to examine key concepts that may appear ambiguous to the reader. The concepts include the following:

Biotechnology

Since the dawn of agriculture, human beings have been manipulating crops to enhance their quality and yields. Biotechnology can be defined as any technique that uses living organisms or substances derived from them to make or modify a product, improve plants or animals or develop micro-organisms for specific uses.[15] Biotechnology can be viewed from different areas or fields. They include agricultural, health, environmental and industry. This study is concerned with agricultural biotechnology and as such, could be viewed as deriving direct relevance from the use of modern tools in plant biotechnology. According to G. Persley, agricultural biotechnology has four folds namely: plant tissue culture; molecular makers; diagonistic and germ plasm technology.[16] All these folds play their roles in crop improvement, positive agricultural productivity, nutritional quality of crops and environmental protection aimed at ensuring food security.[17]

Biotechnology revolution is a major change on how we approach agriculture and these changes are incremental to the scientists who are engaged in it. It provides a means of designing crops for specific environments which is a major departure from traditional agriculture. It is hoped that it will play a key role in the bid to feed the world's expanding population with fewer inputs and on less and less available land.[18] Writing in line with this, S.M.Alhassan is of the opinion that "biotechnology application may be considered more appropriate to solving our agricultural and poverty reduction problems, as it minimizes inputs while increasing yields."[19] By increasing a crop's ability to withstand environmental factors, growers will be able to farm in parts of the world currently unsuitable for crop production. The application of tools of modern biotechnology to the genetic improvement of the Institute's mandate crops may perhaps be identified as a crucial step in overcoming some of the serious constraints encountered in conventional methods.

Minisett

This is a technique used in obtaining healthy planting materials in commercial quantities, thereby solving the problem of availability due to the competition or in other cases makes quality materials available. This technique was developed in Nigeria in the late 1970s for the production of seed tubers separated from the production of root crops more especially yam tuber, by the NRCRI, Umudike and IITA, Ibadan.[20] According to G.N Asumugha," the minisett technology is an alternative to the production of seed yam through milking of yam."[21] He further explains that the process involves harvesting of yam tubers before full maturity and replanting of the head to enable it grow into small tuber that is big enough for planting in the following year. Writing from the same perspective, Z.E. Kalu is of the opinion that it offers an opportunity for commercial production of seed yams. He upholds that the technique requires only 6-33 per cent of the number of tubers needed for the traditional planting system and results in a planting system that requires plants superior to those produced by the traditional method.[22]

Root and Tuber Crops

They are edible- rich, underground plant structure developed from modified roots while tuber crops are those structures wholly or partly from underground stem. According to R.C Okigbo, "they are a group of stable, cherished worldwide for their underground storage organ, crops in this group include cassava, yam, sweet potoato, cocoyam, ginger and a host of other under-utilised crops such as tumeric, rizga, hausa potatoes, amora, tiger nuts and many others."[23]These crops are very important for food security and economic empowerment of most Nigerians. This accounts for why the poorest farmers and food insecure people are highly dependent on it as a principal source of food, nutrition and cash income.

C.N Egesi describes "root and tuber crops as the key to food security and poverty reduction in Nigeria as most households are dependent on their production, processing and marketing as potential sources of food, income and employment."[24]

Genetics

Genetics is the study of genes, genetic variation and heredity in living organisms. It is generally considered a field of study in biology and intersects frequently with many other life sciences and is strongly linked with the study of information systems. It was Mendel, a late 19th century scientist and Augstiman Friar that established this theory of genetics. It studies traits, inheritance patterns in the way traits are handed down from parents to offspring. Mendel observes that "parents or parent organisms inherit traits by many of descrete units of inheritance."[25] This term stimulates a somewhat ambigous defnition of what is referred to as a gene. It is the study of heredity and variation. Heredity and variation are controlled by genes- what they are, what they do and how they work. The genes inside the nucleus of a cell are strung together in such a way that the sequence carries information that determines how living organisms inherit various features.[26] For example, the offspring produced by sexual reproduction usually looks similar to each of their parent genes. Genetics identifies and explains how these features pass from one generation to the next. In addition to inheritance, genetics studies how genes are turned on and off to control what substances are made in a cell-gene expression, and how a cell divides- mitosis or meiosis.[27]

Hybrid

This is the offspring of two plants or animals of different species or varieties, especially as produced through human manipulations for specific genetic characteristics. It can also be known as a crossbreed, resulting from joining the best qualities of two or more organisms or plants of different breeds, kinds, varieties or species through asexual reproduction.[28] Hybrids cannot always intermediate between their parents, such as in

blending inheritances, but can show hybrid vigour, often growing larger or taller than either parents. According to S.C Cornell, the concept of hybrid is interpreted differently in animal and plant breeding, where these interests are in the individual parentage. In genetics, attention is placed on the quantities of chromosomes, according to him, in taxanomy or classes of plants and animals, a key question is how closely related the parent species are. The species are knitly related and sometimes they are reproductively isolated by strong barriers to hybridisation which includes morphological differences, differing times of fertility, mating behaviours and physiological rejection of sperm cells or the developing embryo, some act before fertilisation and others after it.[29] Similar barriers exist in plants, with differences in flowering timers, pollen vectors, inhibition of pollen tube growth. A few plant and animal species, however, are the result of hybrid specialisation, including important crop plant such as cassava, where the number of chromosomes has been doubled. Human impact on the environment have resulted in an increase in the intra-breeding between species, with introduced species worldwide which have resulted in an increase in hybridisation.[30]

Trait

This is a particular feature or characteristic that can produce a particular type of behaviour. A genetically determined characteristic or condition which may be physical, such as hair colour or leaf shape; they may be behavioural such as nesting in birds and burrowing in rodents. Traits typically result from the combined actions of several genes, though some traits are expressed by single gene. According to M. Rustell, trait is a particular feature, quality or trending that someone or something has. These personal plant or animal traits show up early in life or existence. It implies that a particular characteristic can produce a particular type of behaviour. It involves genes and characteristics of organisms. It is a model for structuring object-oriented programmes.[31]

Agricultural Research Institute

This is an establishment put in place for the purpose of conducting agriculturally-related researches. It conducts theoretical research in the principal fields of agricultural science, indicates fundamental new ways of achieving technological progress in agriculture and improves research methods, thus contributes to both theory and research effectiveness. G.B. Ayoola is of the opinion that "agricultural research institutes studies and synthesises the achievements of science and contributes to the widest possible application of achievement in agricultural production, and researches into improved farming techniques, hybrid crops, value added products, of all plant and food crops."[32] He further upholds that agriculture worldwide has been given a new face-lift as a result of the research institutes. Improved gross income of many industralised nations and virtually all the countries in Africa is as a result of the activities of the institutes. Lending his voice to the foregoing, K.O.Olanyinka is of the opinion that "the research institutes bring together academic talents from across a range of disciplines to solve problems of global importance, it is also the engine house that moves the economy to an upward curve."[33] He however regreted that, it only works behind the scene and its impact is not felt directly by majority of Nigerians.

Refils

This acronym means Research Extension Farmer Input Linkage System. It is an umbrella organ that coordinates research and extension services of the ADPs in Nigeria. It is a representatation of institutional dynamics of linkage between the National Agricultural Research Institutes, Agricultural Development Programmes, farmer and input agencies.[34] It is an organisation of research extension and input agencies aimed to improve productivity of farmers. According to J.U Agbamu, "the concept is that village extension workers pass information to farmers on inputs and market situations; it is usually used by the research institutes to ascertain the level of their innovation acceptance by the farmers."[35] The concept

of linkage implies the communication and working relationship established between two or more organisations pursuing commonly shared objectives in order to have regular contacts and improved productivity. A.K.Akinyemiju identifies REFILS as a communication method used by none university based scientists to contact farmers in Nigeria. It is the most effective linkage system in Nigeria, and is also very important in agricultural development in that it helps in the identification of inhibition to free flow of agricultural technologies to all farmers.[36] The linkage helps in the dissemination of technology as well as effective feedback mechanism. When there is, therefore, an ineffective linkage system, it has an adverse effect on the overall agricultural output of the country. Strong linkage system between researchers, extension agents and farmers improves the bottom-top approach system of communication which invariably serves as a mechanism of feedback to research institute and advance solutions back to the farmers.

Innovation

This is the translating of an idea or invention into good or service that creates value for which customers will pay. There are many definitions of innovation, but according to L.B Thompson and J. Ekpere," it is the application of better solutions that meet new requirements, unarticulated needs, or existing market needs. It involves exploitation of new ideas leading to the creation of a new product, process or service that is important, but it is actually bringing it to market, putting it into practice and exploiting it in a manner that leads to new products, services or systems that add value or improve quality."[37] In line with the above definition, Stephen Weiber agrees that it brings total change from the traditional method of doing things but adds that there are many types of innovation such as product innovation that entails the introduction of a new product or a service that is considerably improved; process innovation comprising the implementation of a new or significantly enhanced production or delivery method; supply chain innovation in which innovations transform the sourcing of input

products from the markets and delivery of output products to customers and the marketing innovation, which results in the evolution of new methods of marketing with enhancement in product design or packaging among others.[38]

Theoretical Frameworks

This study adopted the structural functionalist theory as its theoretical base. The structural functional analysis was developed from the works of Gabriel Almond – a renowned American political scientist, who stated in his work, *Structural – Functional Analysis* (1965), "that every political system has specific functions to perform."[39] In other words, each political system is different from the other through the functions it performs. Also, in his most celebrated classical work, *The politics of the developing area*, Almond draws our attention to an interesting issue. He argues that though there are differences between developed and developing countries so far as structures of the system (such as interest group, bureaucracies and legislatures) are concerned, yet their importance is immense. He observes that for every system to subsist, it must be able to carry out some given functions.

Advocates of structural functional analysis do agree that in order to understand a system, one must first understand its structure and function, these two are very fundamental to providing basis for understanding the nature and character of the human society. As one of the indispensable functions of government structures, making agricultural policies that will shape and guarantee agricultural development for the actualisation of economic development is not only paramount. It is also the central issue in any meaningful drive to impact the research institutes in Nigeria for agricultural development. The aim of the Federal Government in establishing the National Roots Crops Research Institute, arguably, the functional aspect of the structure of government in funding research institutes has not been met. This attitude has failed to encourage them in advancing their objectives. While the

Federal Government has variously declared its readiness, to develop research institutes in Nigeria, it's unwillingness to finance these institutes has exposed government lackadaisical attitude towards research institutes. Simply put, the construction of structural functional theory as espoused by Almond presupposes that the structures of government must perform the constituted functions in order to maintain equilibrium in the society and when the structures fail to perform the constituted functions, the society suffers some retrogression (Research Institutes). Hence the poor state of research activities at the institute is a consequence of the inability of the governmental structures like the Ministry of Agriculture and Water Resources and the Federal Government failing to perform their functions. For research institutes to have strong impact on the society, the functions such as provision of funds and infrastructure must be met by the parent ministry as well as the Federal Government of Nigeria.

Literature Review

The purpose of this section of our study is to discover relevant variables that have been shown to be important in the problem area by previous studies. It is also aimed at obtaining useful information from previous studies that can be extended to the present study, by way of yielding new information which is unknown to current readers.[40]

In G.N.Asumugha's and E.O.Mbanaso's *Guide to Umudike Agricultural Research and Training Station*, the history of the research institute has, to a great extent, been revealed, "the federal agricultural research and training station at Umudike is located 8 kilometers south-east of Umudike Ibeku and 138km north off Port Harcourt, the nearest seaport and air field."[41] The station first started as a provincial experimental farm on 1st January, 1923. Then, the activities of the farm were controlled by the Nigerian Department of Agriculture, with headquarters at Moor plantation, Ibadan. The book further reveals that, "as a result of political changes, which took place in the early 1950s, most government departments

including agricultural departments were regionalised in 1954. Agricultural stations in Eastern Nigeria were controlled by a director of agriculture headquartered at Enugu, following the regionalisation. In 1956, the Eastern Nigeria Research Station was established at Umudike and it took over the site of the provincial farm.

In 1962/68 development plan in which agricultural development generally was given due providence, the station would have been considerably developed through a loan agreement between the United States Agency for International Development (USAID) and the Eastern Nigerian Government. In this agreement, the USAID was to provide funds for capital development totalling about 2.632 million dollars, while the Government took care of recurrent costs estimated at twenty per cent of the capital costs of expansion. By 1966/67, large quantities and commodities (stores, vehicles, equipment etc), arrived from the U.S.A. Unfortunately, this plan of development was not implemented before the outbreak of the civil war.[42]This work details the history of the National Root Crops Research Institute Umudike. However, the work stops its analogy to the period of the Nigerian civil war. This present study will trace the history of the National Root Crops Research Institute, Umudike, further from 1976 to 2014, in order to complement the one that stopped during the civil war.

In another work by U.C.Ukawundu entitled, *National Root Crops Research Institute and the Development of the Nigerian Economy*, the author is of the view that the research, institute has since its inception increased the scope of research, especially on root crops such as cassava, yam, sweet potato and cocoyam which were major food crops in the eastern states. In a broad outline, research projects such as crop improvement, soil fertility, management, cultural practices, diseases and their control, pests and their control, processing, storage and product utilisation are covered. Results obtained he argues, were put into practical farming and helped in enhancing the country's agricultural development which has been feeding the countries teeming population.[43]

He further opines, among other things, that

> *The National Root Crops Research Institute, Umudike, which started as a provincial farm in 1923 was upgraded to a commodity institute in 1975 and renamed in 1976 and has the National mandate for research into the genetic improvement of root and tuber crops including yams (dioscorea spp), cassava (manthot) potato (1 pomoea batatas (L) Lam), cocoyam (xanthosoma and colocassia spp), ginger (zingiber officinale Rosec), sugar beet (Beta vulgare, living stone potato, ple ctranchus esculenta, N.E. Br) and other root crops. Research into farming system of the entire South-Eastern States.*[44]

Moreover, he posits that,

> *The research activities of the institute are organized into programmes which include cassava, yam, minor Root crops, farming system, Extension and post harvest Development headed by coordinators. There are five divisions: Root Crops Research, Tuber Crops Research, Farming System and Extension Research, Planning, Monitoring, Evaluation and Biotechnology.*[45]

The work further shows that the institute maintains five (5) sub-stations spread across the country and they are located in Kuru in Plateau State, Otobi in Benue State, Igbariam in Anambra State, Nyanya in Nasarawa State and Maro in Kaduna State."[46]

The book extensively describes the history of the National Root Crops Research Institute, Umudike, although it did not include the problems encountered by the research institute. The present study considers the problems of the institute at Umudike, and also dwells on the new out-station at Iresi, Osun State, as well as the activities.

Another important contribution to the history of the National Roots Crops Research Institute, Umudike, is by G. N. Asumugha and E. O. Mbanaso entitled *National Root Crops Research Institute, Umudike, Agricultural Excursion Guide*, the authors state that,

> *National Root Crops Research Institute, Umudike started in 1st January, 1923 on a 122 hectare land as a provincial Research farm under the Nigeria Development of Agriculture with headquarters at Moor plantation, Ibadan following regionalization in 1955, it came under the Eastern Region Ministry of Agriculture, under Director of Agriculture, Enugu. In the same year, the school of Agriculture was*

> *established and located close to the research farm. Subsequent acquisition of 165 hectares in 1960/61, 162 hectares in 1965 and some swamp land in 1974/75 brought the total hectares to 418 hectare. In 1956, the Research farm became known as the Eastern Nigeria Agriculture Research Station (ENARS). Both the Research station and the school were merged in 1965 and called Research and training station (ARTS). On April 1st 1972, the Federal Government took over the station and renamed it the Federal Agriculture Research Institute by Decree of 1973, the station came under the Agricultural Research Council of Nigeria (ARCNC). The station was upgraded to a commodity research Institute in 1975.*[47]

To further strenghthen their argument, Asumugha and Mbanaso are of the opinion that,

> *the transfer of the College of Agriculture to Ishiagu in Ebonyi State in 1993 and the cession of the area formerly occupied by the college to the Michael Okpara University of Agriculture, Umudike gave rise to the acquisition of a land area of about 308 hectares.*[48]

To this end, they added that the Federal College of Agriculture Ishiagu in Ebonyi State is considered a training arm of the Institute. This is a detailed work in the history of the Institute. However, the work does not contain the activities of the different departments that make up the institute for its smooth functioning, so as to achieve its mandate. This aspect has been captured in this study.

Another related work by E.C.Umunnakwe entitled *Concept and Development of the National Root Crops Research Institute, Umudike*. The study explains that the Institute did not work in isolation to achieve its aims and mandate, rather it collaborated with some sister institutes. Accordingly, it underlines that:

> *The collaboration with research and donor agencies is at the international, regional and local levels. The collaborators include the international Institute of Tropical Agriculture (IITA) Ibadan, Food and Agriculture Organization (FAO) Rome; International Atomic Energy Agency (IAEA), Austria, International Plant Genetic Resource Institute (IPGRI), Rome; International Center for Tropical Agriculture* (CIAT) *Colombia, United States Department of Agriculture (SDA), USA, International Laboratory for Tropical Agricultural Biotechnology (ILTAB), USA, and the National Center for Genetic Resources and*

> *Biotechnology (NACGRAB), Abuja others include Shell Petroleum Development Cooperation (SPDC), Niger Delta Development programmes in the South East agro-ecological zone of the country, faculties of Agriculture in the South East Universities such as Michael Okpara University of Agriculture Umudike, Federal University of Technology, Owerri, University of Calabar, University of Uyo and the University of Nigeria, Nsukka). Also included are the West and Central African Regional Development (WECARD), Strategic Food Resources (SFR), Abuja, NGOs as well as the World Bank and the International Fund for Agricultural Development (IFAD).*[49]

This work explained in detail those that collaborate with the Research Institute, Umudike, thereby bringing the Institute to limelight. However, the work does not go into details in explaining the nature of the collaboration and the importance of this collaboration for the development of the National Root Crops Research Institute, Umudike. This work will review the result of the collaborating activities with a view to establishing the part it played in the overall growth and development of the research Institute.

A.A. Ibrahim, S.B. Mustapha and B.T. Mamza have, in their study, examined the Lake Chad Research Institute (LCRI), Maiduguri, as one of the agricultural research institutes in Nigeria. According to them, LCRI has the national mandate for the genetic improvement of crops and livestock in the north-east agro-ecological zone, covering Adamawa, Borno, Gombe, Taraba and Yobe States. This institute serves as the zonal coordinating institute for the implementation of Research Extension Farmers Imprints Linkage Systems (REFILS) in the zone. The institute, operates in collaboration with the Agricultural Research Council of Nigeria (ARCN), Abuja, established the agricultural research outreach centres in two secondary schools in Borno State within 20 kilometres radius of the institute.[50] Ibrahim Mustapha and Mamza have, in their study, further revealed the impact of this institute on its location as well as the problems the institute has been facing. However, the study fails to divulge the operational activities of this institute, as well as its structure. This could be as a

result of the fact that these scholars never considered these areas as important aspects of the study of agricultural research institutes. This study holds the view that the features and operational activities are an important aspect of any worthy study dwelling on agricultural research institutes situated in Nigeria, such as the National Root Crops Research Institute, Umudike.

B. Hajirostamlo, N. Mirsaeedghazi, M. Arefnia, M. A. Shariati and E. A. Fard, in their work, *The Role of Research and Development in Agriculture and its Dependent Concepts in Agriculture*, are of the opinion that research institutes are needed for the development of agriculture. According to them, research development was the best solution for agricultural development. Average income remarkably increased in developing countries and this growth was related to increasing human resources.[51] The authors further uphold that using modern methods gave room to efficiency which was considered as an inevitable factor in increasing the supply of agricultural produce.[52] Agricultural research institutes were established to research into new and modern methods of agricultural activities, increased yield and cause improvement in technology, all these worked together to increase agricultural development they maintain. These authors extensively discuss the roles of agricultural research institutions. However, their study fails to explain operational activities of these research institutions. This could be attributed to the fact that they are not historians but agriculturists, a situation which creates a gap in their work. This study buttresses the fact that any study on research institute without its operational activities needs to be re-visited, using the National Root Crops Research Institute, Umudike, as a case study.

In another work, *The Role of Research in Agricultural Development*, Adenike Olufolaji has outlined the place of agriculture in the development of an economy. According to this scholar, the agricultural sector has greatly contributed to employment creation, poverty and hunger reduction, and reduction in rural-urban migration, among others. Olufolaji further

traces the origin of research institutes in Nigeria. As she points out, agricultural research in Nigeria started more than 100years ago with the establishment of a botanical garden in Lagos during the late 19th century. By 1903, the Forestry and Botanical Departments (renamed agricultural departments) for Southern Nigeria had been created. By 1912, the latter was divided into Northern and Southern regions. Ealier in 1910, the forestry and veterinary departments had been created, and the Fishery Department evolved in 1951.[53] In a nutshell, by the 1970s and 1980s, different research institutes and departments of agriculture had emerged. At present, Nigeria has the largest and most elaborate national agricultural research systems in sub-Saharan Africa.[54] She goes ahead to explain that part of the task of research institutes is to acquire information on agricultural activities of other countries, whether developed or developing economies of the world.[55] The author does a tremendous work by analysing the growth and development of agricultural research institutes in Nigeria but fails to recognise in her analysis the place of the institute in agricultural development. Furthermore, she identifies some salient aspects of agricultural research institutes in Nigeria after a comparative analysis of agricultural activities in developed countries with those of Nigeria. But, the study fails to point out the relevance of the research institutes to the overall development of agriculture. This could be as a result of an oversight or neglect of the National Root Crops Research Institute at Umudike. This study will explain the history of the institute, and identify its importance in the economic development of the country. The study also highlights the different phases that the National Root Crops Research Institute, Umudike, has gone through as an agricultural research institute in Nigeria.

In his own contribution, M.G. Maiangwa in his *Importance, problems and Reform of Agricultural research in Africa*, has observed that agricultural research institutes are very vital in meeting the economic developmental needs of any nation. According to him, "increasing agricultural activity remains a central concern of level of income of the

agricultural sector in meeting the food requirements of continually expanding populations, in generating foreign exchange to finance domestic programmes, amongst others."[56] He notes that agricultural research has been playing an important role in the growth and development of the nation's economy which has manifested in production of new technologies and improved products among others. A transformed agricultural research system helped to achieve sustainable food and income security for all agricultural producers and consumers particularly for resources on poor households whether they are in rural or urban areas. The writer in this work attests to the fact that research institutes are very important in the development of a nation's economy. Yet, he does not point out that for a research institute to be functional, there must be an organogram. This could be as a result of the fact that the place of an organogram in such an institute was not considered very vital to the functioning of the research institute. Using the National Root Crops Research Institute, Umudike, as a case study, this study attempts to fill this gap by laying emphasis that the structure is very vital in the smooth functioning of every research institute, and that every research institute needs an organogram which is essential for its smooth operation.

Another important contribution to studies on agricultural research institutes is M. B. Waite's viewpoint contained in his *The American Industrial Opportunities*. This study deals with the importance of research as a means of increasing agricultural production. Waite is of the opinion that a rapid increase in the utilisation of science and the result of scientific research as a source of information and guidance for improving and perfecting agricultural methods is a new method in the area of modernising agriculture.[57] According to him, research in agriculture may be divided into two main classes: agricultural research and scientific research, and both go hand in hand in the smooth running of research undertakings. Agricultural research is concerned with actual methods of growing and utilising crop plants with animal production among others while scientific research activities include development

of agricultural methods and subjecting them to critical experimentation. He further highlights that it involves gathering methods developed in various parts of the world and testing them out experimentally under given conditions. It utilises precepts developed in the sciences or rather tests their availability for use in actual practice by trying them out in the field. He further reiterates the fact that at the present time research institutes are influenced by scientific data. It takes into consideration all such questions as depth and kind of tillage, varieties of crops to be planted in different localities, depth, distance and time of seedling and planting, varieties suited for different sections and different purposes, rotation of crops, kinds and amounts of fertilizer to be used, time and amount of water, and in fact, all the routine practices of actual farming.[58] The study reveals, to a considerable extent, the actual work of research institutes, which is mostly in the research of better output yielding crops. Notwithstanding, the study could not point out the departments/divisions that handle all these activities in research institutes. This lacuna is filled up in the present study which reveals that, there exist departments in the research institutes assigned to carry out specific duties for the smooth running of the institutes. Using the National Root Crops Research Institute, Umudike, as a point of reference, our present study goes to establish the fact that where the work of one terminates the other department will continue until the satisfactory output is achieved.

E. Porceddua and R. Rabbinge in their work, *The Role of Research and Education in the Development of Agriculture in Europe*, are of the view that agricultural research and education in Europe have played a major role in the advancement of agriculture and land use during the last century. They further argued that "the scientific basis of agriculture has been strengthened by the use of insight, knowledge and the expertise in the farmer's field, and is now widely adopted. As a result of this development, productivity per hectare, efficiency and efficacy of use of external inputs have increased considerably."[59] Multiple goals of agricultural production, protection of the environment, nature conservation and development

will be achieved by a combined effort of research and education.[60]The authors in their study highlights the importance of education in agricultural development through research which is commendable, but they do not identify the problems of the research institutes in agricultural development. The reason could be attributed to the fact that they do not seem to consider the problems of research institutes as a vital area of study. The possible reason for this could be that they are agricultural scientists, and not historians. With reference to the NRCRI, this researcher hopes to x-ray the problems faced by agricultural research institutes in Nigeria.

Ibrahim Abdulahi in "*Research Institutions, Important to Agricultural growth",* has upheld the view that agricultural research institutes are important for agricultural growth. In his opinion, small holder farmers can become the bedrock of food security in Africa provided they could access the essential ingredients of modern agriculture like quality seed of improved crop varieties.[61] According to him, research institutes play vital role not only in Nigeria but everywhere. "Seed is a technology and also a product of research, and as such can not be produced without research and these institutes are always engaged in how to improve on existing varieties or developing new varieties."[62] There are lots of challenges in getting seeds in terms of drought, weather, pest and diseases, and these researchers keep working day and night in order to address existing challenges and upcoming ones. Furthermore, he reveals that research institutes develop seed varieties to see the light of the day, but regretted that even when it was registered and released it takes time for it to be commercialised.[63] The author has gone a long way to conceptualising the idea of research institutes in Nigeria, reasons for their establishments and their functions. But the work could not explain the relationship and the effects of the relationship on the products of the research institutes on the economic development of Nigeria. This could be as a result of the fact that the writer is a seed research production expert. The present study will show that research institutes do not work in isolation for economic development to take place; rather, they work with farmers,

students, co-operative societies, and so on, for the development of agriculture which invariably metamorphoses into economic development of Nigeria.

C. Thirtle, L. Lin and J. Piesse in their work, *Impact of Research led Agricultural productivity Growth on Poverty Reduction in Africa, Asia and Latin America*, argued that agricultural research is good for development and it is a multi-dimensional research that addresses the agricultural challenges of developing and emerging countries. They identified agricultural domain to include: Crop production and animal husbandry; agro forestry; fisheries and aqua culture; agro business and related processes; animal and human health related issues; as well as the sustainable management of the natural sources. To them, farming system output depend greatly on these combinations, along with the socio-cultural and bio-diverse landscapes food systems and ecologies in which it is embedded.[64] They uphold that agricultural research provides technical, economic and institutional knowledge and innovations contributing to sustainable development. They further notes that research - led agricultural productivity has led a documented positive impact on poverty reduction in Africa, Asia and Latin America.[65] These authors have gone a long way in upholding that research institutes make an impressive impact on the agricultural output which invariably transforms to economic development and causes poverty reduction. But they have failed to point out the impact of research institutes on the overall transformation of economic development of any nation. This development could be an oversight due to the high level of poverty on the continent under review. This work reveals that there were other impacts of agricultural research institutes and not necessarily in the area of poverty reduction in Africa and other developing countries, rather on other aspects of the economy. This will be gleaned from the impact of the National Root Crops Research Institute, Umudike.

P. G. Pardey and N. Beintema in their work, *Losing Ground? What Happened with Agricultural Research in Less Developing Countries*, note that "Agricultural research aids

economic development especially for the developing countries, but outline conditions that must first be put in place. They include: careful identification of needs; setting priorities; environmental externalities and the adoption of bottom-up approach aimed at enhancing farmers participation. They incorporation of all these components leads to agricultural development, evidenced in extension, inputs, supply, financing institutions, markets, institutional development, infrastructure investment, capacity building, land and sustainable natural resources.[66] The authors go on to explain that three sectors are involved in overall performance of agricultural research: the private sector, public sector and the civil society. The private sector is the main source of funding in high income countries while public sector has been the main source of funds for agricultural research in developing countries directed at problems of small-scale farmers. The role of the civil society (e.g. farmer organisations, consumer organisations, community-based organisations, among others) in setting research priorities and implementing solutions is increasingly being acknowledged.[67] The authors have greatly thrown more light at the make-up of agricultural research institutes. The above scenario is true and is operational at the NRCRI, while the federal government via the Ministry of Agriculture Water and Natural Resources plays a dominant role as the major financier, the state governments, agricultural based companies, small scale industries, farmers' organisations, co-operative societies, contribute their own quota to the steady growth of the research institutes. The authors do not outline the problems that bedevilled these research institutes. This study reviews the problems of the research institutes in Nigeria with emphasis on the NRCRI.

P. B. R. Hazell in his work, *An Assessment of the Impact of Agricultural Research in South Asia since the Green Revolution*, observes that agricultural research has continued to provide essential output, that has helped to maintain productivity and growth in agriculture, generate high economic rate of returns on investment, directly through the price effects, has

contributed to food security and poverty alleviation both in rural and urban centres.[68] He further observes that apart from using these kinds of studies to assess the economic value of poverty and environmentally oriented research. They also used for better understanding of the potential trade off and complementaries between attainment of productivity, social and environmental goals in agricultural research. They are also used for determining the kinds of research that offered the best prospects of win-win outcomes.[69] According to him, agricultural research has come a long way at poverty reduction. Research institute generates food surpluses, helpes to overcome widespread malnutrition in South Asia due to insufficient calorie and protein intake. Some agricultural research institutes successfully addressed this problem by increasing the production of non-nutrient rich foods, e.g. fruits, vegetables and fish for consumption and by increasing market and supplies that have lowered the prices of products for the poor.[70] The writer undertook a very impressive study on the impact of agricultural institutes but could not address the problems faced by these research institutes. The probable reason for this could be as a result of the overwhelming impact of the research institutes on poverty reduction. This study undertakes the problems of the agricultural research institutes in Nigeria focusing on the NRCRI.

Julian Alston, in his journal article entitled, "The Benefits from Agricultural Research and Development, Innovation and Productivity Growth," has described agricultural research and development as encompassing an extremely broad range of activities and potential innovations. He identifies fourteen best bets which includes among the following; developing hybrid seeds with improved yield potential; better resistance to wheat rust; increased drought tolerance and added nutritional value. It also encompasses the development of new animal vaccines, better fertilizer use, improved processing and management techniques for fisheries.[71] He also argues further that stable successes in seed development seem to have generated immense social benefit. The high yielding varieties that spread through are often

credited with driving doubling of rice and wheat yields in Asia. From the late 1960s to the 1990s, it has helped in saving hundreds of millions of people from famine. Given the prevalence of hunger and high proportion of the extremely poor that work as farmers, agricultural research and development seem to offer a potential opportunity for effective altruism.[72] The writer goes a long way at explaining the activities that go on at the research institutes, examines its importance to the growth and development of agriculture which is evidenced in economic development. However, the writer does not to acknowledge the problems facing research institutes worldwide; the reason for this could be that he never considers problems as salient in the study of research institutes.

Isiaka Ogumade in his book, *Evaluation of Agricultural Research Institutes in Nigeria*, explains that the dream that led to the establishment of agricultural research institutes in Nigeria was clear, the vision untainted and the mission remained sacrosanct. That is to say that, agricultural research institutes, majority of which were established before Nigeria's independence to be the bedrock of agricultural revolution in an emerging country called Nigeria, were well conceived. The idea was to make the institutions a hub of research field for all available agricultural produce (food and cash crops), and make it available to farmers and investors who will turn it out into a gold mine which will eventually translate to food surpluses in the country. According to him, today the dream has become dead, the vision blurred and the mission a mere statement of expression as majority of the institutes are a mere shadow of themselves due to poor funding, corruption, poor government policy, late budget, bureaucracy and total neglect.[73]

Obviously, the effect is well pronounced, the most apparent being the unbridled importation of virtually all notable food crops including tooth pick into the country. Apart from this, lack of technological framework to maintain research programmes, deficiencies in facilities and equipment and low agricultural research investment among other factors make

nonsense of the notable structure on ground.[74] The author does an impressive work by outlining the problems of research institutes and going by this narrative, one would think that agricultural research institutes in Nigeria are now moribund. This was a general statement on the state of all agricultural research institutes in Nigeria. This could be as a result of the general belief that Nigeria has no maintenance culture, and that anything owned by government belongs to nobody. Be that as it may, this study will stand to attest to the fact that Research Institutes are moribund, as painted by the author, basing our judgment on the NRCRI, Umudike in Abia State. This work discusses the gains and the positive impact of the institute to the economic development of Nigeria.

Hermann Weibel in his work, *Impact Assessment of Agricultural Research for Developing and Poverty Reduction,* is of the opinion that agricultural research is one of the main factors that contribute to the shift in agricultural production system and changes in the rural area. In specific terms, it helps to improve productivity, increase agricultural incomes and change agricultural practices. In fact, "various impact assessments have shown that it is one of the most effective investments when it comes to increasing agricultural production."[75] He further observes that for many years, the primary objective of agricultural research has been an increase in yields and production. It has recently evolved in increasing resilience, improving nutrition and women empowerment.[76] The writer extensively expounds the importance of research institutes, he channels its importance mainly to input improvement. This is commendable as it is based on one of the roles of the research institutes. However, he de-prioritises all other reasons for the establishment of agricultural research institutes with emphasis on the overall impact of research institutes on the development of the economy. This could be as a result of the fact that he never considers all other aspects as partners in progress in the development of research institutes. The present study uses the NRCRI,

Umudike, which is one of the agricultural research institutes, as a case study, showing that research institutes occupy a significant position in the economic development of a country.

In one of the chapters in the book, *Agricultural Research, Livelihood and Urban Poverty in China and India*, S.A.Fan shows that the funding rate for agriculture and food research initiative has dipped to barely ten per cent. In this highly competitive environment, many talented scientists and researchers are unable to get funding and as a result neglect agricultural sciences at a time when the need for their innovation is greatest.[77] Rather, they take their expertise to other countries that are more supportive of public sector research. Continuing, the writer believes that research funding shortfalls have continued even in the face of anti microbial resistance, pollinator health and nutritional outcomes and the need for innovations for advanced manufacturing and economic enterprises. Funding research in response to these challenges should be considered critical to the nation's future, an investment that will pay huge dividends in years to come.[78] He further upholds that appropriate funding of research has led to new ways of dealing with influenza virus in pigs; increased milk production with fewer resources; innovative and effective ways to manage pests; innovations in irrigative technologies; significant boosts in wheat; corn development of new sensor to detect and to deal with pathogens of food safety without relying on antibiotics; protection of pollinators and new economic enterprises and jobs.[79] The study is well articulated on the need for funding research and gains of the funding of research. However, the study only lays emphasis on research funding as if it is the only thing that needs to be done for the growth of the research institutes. Furthermore, he does not examine the structure of the research institutes. This could be an oversight. This study identifies other problems of research, militating against the growth and development of research institutes in Nigeria, as well as the structure of the research institutes using the NRCRI, Umudike as a guide.

N. Roling in his work, "*The Agricultural Research Technology Transfers Interface: A Knowledge System Perspective*" observes that to fight hunger, African countries need economic growth and food security which implies food availability, access or capacity to purchase food.[80] Agricultural research can help bring about the increased production. However, these institutions cannot operate in a vacuum, irrespective of how good they may be. Writing further, he attests to the fact that research requires considerable investment of capital and operational budgets to be effective. He then defines research as the development of better crop or livestock germplasm to suit a particular demand or generation of new technology to solve a particular constraint. He further explains that scientists should be involved in basic strategies, applied and adaptive research. This should be in conjunction with subject matter specialists and farmers seen as participants in a single agricultural knowledge and information system. He further argues that research has helped in continuous and dynamic process of developing and diffusing new technology.[81] He further looked at the makeup of research institutes and concludes that funding is a major step to the death of or otherwise of the research institutes. He goes on to applaud the complimentary role played by other partners like farmers for the growth of our research institutes. This work gives precise definition of research institute and reasons for its establishment, however, the writer fails to acknowledge that there are different departments in Research Institutes that take up different aspects of research. This could be attributed to the fact that he is not very conversant with the make-up of research institutes. This work stands to attest to the fact that research institutes are made up of divisions that help in its day-to-day running using the NRCRI, Umudike, as the focal point, by bringing to bare the activities of the different sections of the institute.

I.E. Aguolu in his *A Review of Government Policy on Agricultural Mechanisation in Nigeria,* outlines the benefits derivable from agriculture, which includes sustainable food production and economic development, which are of strategic importance to all nations.

Developed and developing countries alike recognise the importance of agriculture by according it the priority it deserves. He further emphasises that over the years, government has established several agricultural institutes, colleges and universities.[82] The author further reveals that research institutes were established to improve agriculture through dissemination of agricultural information as well as guide policy makers of the government.[83] The study does not look at the features and the operational activities of these research institutes. This could be attributed to the fact that he never considered them as an important aspect of studies on agricultural institutions. By identifying the organogram of the NRCRI, Umudike, this study attests to the fact that organogram is very important for the smooth running of administration in any research institute in Nigeria.

And for R. E. Evenson in *Economic Impacts of Agricultural Research and Extension*, states that, Agriculture is in need of constant research. In his opinion, agricultural growth needs new approaches to farming, solving the future challenges in a more sustainable manner**.** "We need to invest in research and innovation and ensure that our investments are translated into concrete results on the ground, we have to put agriculture and food research as key components of the bio-economy."[84] He further admits that, it is clear that an increase in research funding will work best if we can create the right environment for innovation to thrive. Agricultural innovation has to be more than just a one-way transfer of results to practice. He also observes that innovation prospers when the world of research and farming interact by continually sharing knowledge, ideas, and thinking together.[85] He also observes that boosting the awareness of innovative solution and practices has been identified as a weakness within agricultural research. This study proves that the issue raised affects all agricultural Research Institutes, but that the National Root Crops Research Institute Umudike has put lots of machineries at work to check this menance.

Z. Griliches in his work, *Research Costs and Social Returns,* is of the opinion that "Individual agricultural activity has declined over the years and that raising productivity of agriculture per worker can only be significant through research institutes' activities. It is only then that its contributions to economic growth and alleviation of poverty can be used for investment in agricultural and non agricultural sectors."[86] He further observes that agricultural yields have also been on the decrease for many crops in many African countries. He reviews agricultural research funding as a panacea to economic stagnation and poverty in Africa. To him, investment in agricultural research is a key factor in increasing agricultural productivity thereby helping to stimulate growth, generate income and reduce poverty. With this development in place, growth in agricultural productivity can serve as an engine of growth for the economy by raising the incomes of producers who then spend the resources on rural non tradable goods and services such as housing. He also argues that the private sector is not increasing its research efforts in Africa. He identifies other factors that weaken agricultural research institutes in Africa as lack of linkages between farmers, extension and research systems. Often researchers have little interaction with extension services and farmers, and do not reflect their priorities in the research agenda. In some cases, national research programme is defined by donors and may have little relation to national objectives of farmers needs. The lack of linkages leads farmers to adopting less than ten per cent for the crop varieties,[87] farmers never learn about new technologies developed by the research institutes because of lack of effective mechanisms to transfer innovations from research to the extension system. Finally, the extension services have often failed to reach farmers as a result of non-effective communication strategies. Both research and extension services in Africa depend heavily on donor funding "Contribution donors now provide more than forty per cent of all funds for agricultural research, given the fragile economies and extensive demands in the public sector in many African countries.[88] The author has presented to us some of the

problems of agricultural research. This work will include the importance of structure in research institutions in Nigeria using the institute Umudike as a case study.

O. Omorogiuwa, J.Zivkovic and F.Ademola, in their study on the "*Role of* Agriculture *in the Economic Development of Nigeria*" are of the view that "Africa is rich in natural resources and identified the fact that taking appropriate measures can speed up its economic development. According to them, at this point in Nigeria's development, the best approach is on the agricultural sector. In order to move forward, the country must increase the low productivity of current agricultural output, engage in competition within the agricultural sector, develop domestic policies and increase agricultural funding.[89] The study further reveals that to improve Nigeria's economy, emphasis should be placed on all the components of agriculture. The findings of these authors are applaudable but they failed to point out that subsistence agriculture cannot lead to the development of agriculture for national development. They fail to point out the place of research institutes in the development of agriculture. This could be attributed to the fact that they never considered the role of agricultural research institutes in the development of agriculture. This study is evidenced on the fact that research institutes are very important in the development of agricultural sector which leads to overall economic development. It also highlights the activities of the research institutes in Nigeria, using the NRCRI Umudike as a case study.

Arguing on a similar line, U. Muhammad, A. Lawal and O.A Atte in their work on "*An Analysis of Agricultural Production in Nigeria"* are of the opinion that the main problems of Nigeria stem from her inability to access the natural and human resources. In their study, they observe growth in agricultural subsector and its contribution to the Nigerian economy. They also identify the various factors that impacted on the national agricultural production in Nigeria, and specifically examined sectors such as crops, livestock, fishery and forest. It considers factors like population growth rate, GDP growth rate, consumer price

index, food import values and the expenditure in government in the agricultural sector.[90] However, the authors do not examine the role of research institutes on the development. The reason for this could be an over sight or deliberate neglect or deliberate neglect, omission of the impact of research institutes on the agricultural output of the economy. This study examined reasons for the establishment of the research institutes and the impact on the Nigerian economy; using the NRCRI Umudike as a guide.

Arising from what the researcher has highlighted in the foregoing paragraphs, where a number of literature has been reviewed, in subsequent chapters the study plans to examine in detail; a review of the history of agricultural research institutes; and by extension, in other chapters, the study aims to consider the National Root Crops Research Institute, Umudike, among other subjects. Altogether, the study hopes to employ a historical perspective which may not have been employed in some of the literature that have been reviewed in the foregoing paragraphs.

Organisation of the Study

This study is divided into seven chapters for proper presentation and for easier understanding. Chapter one introduces the work under the background of study; scope of study which establishes the parameters of the research; statement of the problem which brings up the underlying problems that propelles the researcher to investigate this problem; purpose of the study stating the objectives to be achieved; conceptual classifications where various concepts in the research work are clarified; theoretical framework; literature review; and methodology. Finally, there is the organisation of the study.

Chapter two reviews the history of Agricultural Research Institutes in Nigeria. To this end, the study surveys the features and mission statements of the agricultural research Institutes in Nigeria and the administration of research institutes.

In chapter three, the study examines the history of the National Root Crops Research Institute Umudike, Abia State, taking into cognizance the historical background, geography and physical features of the institute. In addition, the study examines the structure of the research Institute, the various experiments so far conducted at the Institute, funding, staffing, activities of the sub-stations and the achievements of the research Institute.

In the fourth chapter, the study focuses on the operational activities of the Institute.This examinatination is particular about the activities and achievements of different divisions and programme- Root crops research, Tuber crops research, Farming system research and Extension, Planning monitoring and evaluation, biotechnology and product development.

Chapter five explores the various means by which the institute disseminated its innovations and techniques and the impact of these activities on agricultural development. To this end, the study also reviews the activities of the trainer trainee, cooperative societies, adopted village and adopted school programmes among others.

The sixth chapter discusses the constraints/ challenges of the NRCRI, Umudike. These challenges are reviewed from the area of funding, poor extension service by the institute, poor remuneration, brain drain, human resource development among others. The work is concluded in the seventh chapter with the summary, conclusion and recommendations.

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CHAPTER TWO

HISTORY OF AGRICULTURAL RESEARCH INSTITUES IN NIGERIA

In this chapter, a survey of the development of agricultural research institutes is done. The aim is to place their history in a proper perspective. Agriculture is known to have continued to remain a major driver of economic growth in Nigeria. The role of Nigerian agricultural sector includes the provision of food for the growing population, foreign exchange earnings, provision of the labour force and provision of income for the farming households. It employs about two-thirds of Nigeria's total labour force.[1]

Agriculture in tropical Africa and especially in Nigeria, may be dated back to ages. History has it that the early man was a wanderer, a fruit gatherer, a hunter and had little or no knowledge of agriculture.[2] However, with the increase in population, land, fruits, animals, and food became scarce. For this reason, the early man made the first attempt at domesticating plants and animals and this marked the origin and the first stage of agricultural development in Africa.[3]

Following this, the early man became a subsistence farmer and his first farming practice was shifting cultivation. Crude implements as hoe, matchets among others were made use of, at this stage. Over time, the practice of shifting cultivation gradually gave way to land rotation, through modern crop rotational system and specialisation. As a result, farmers started to look for means of increasing production efficiency and reducing human labour and crop loss. Agriculture then rose from subsistence level to commercial concern.[4]

Over the years, agricultural research, extension services and agricultural education have become a necessary tool to stimulate development from subsistence level to modern farming in Nigeria. Also, with the advent of the erstwhile colonial authorities, the farmers were encouraged to produce not only the improved varieties but also cash crops like rubber,

cocoa, cotton, groundnuts, oil palm, among others, which fetched them money to procure certain imported and prestigious goods.[5]

The process of transformation from the old-fashioned agriculture to the modern time agriculture has, therefore, brought about remarkable changes that led to the establishment of many agricultural research institutes in Nigeria to enhance production. Agricultural research institutes have thus been established along with other agricultural parastatals in an attempt to bring about meaningful development in agriculture.[6] These agricultural research institutes were known to conduct research into better ways of cultivation, farming, better and more economic ways of producing crops, high quality planting materials and good breeds of farm animals.[7] The agricultural research institutes in Nigeria are thus grouped into five alongside their mandate. These are:

- **The Arable Crop-Related Research Institutes:** The institutes in this group consist of: National Root Crops Research Institute (NRCRI), Umudike Umuahia; International Institute of Tropical Agriculture (IITA), Ibadan; National Institute for Trypanosonmiasis Research (NITR), Kaduna; Lake Chad Research Institute (LCRI), Maiduguri; Institute of Agricultural Research (IAR), Zaria; and Institute of Agricultural Research and Training (IART), Ibadan;
- **Tree Crop-Related Institutes:** These include: The Cocoa Research Institute of Nigeria (CRIN) Ibadan, Rubber Research Institute of Nigeria (RRIN) Benin; National Institute for Horticultural Research (NIHORT) Ibadan; Nigerian Institute for Oil Palm Research (NIFOR) Benin; and Forestry Research Institute of Nigeria (FRIN), Ibadan;
- **Fishery-Related Research Institutes:** Here, we have the National Institute for Oceanography and Marine Research (NIOMAR), Lagos and National Institute for Fisheries and Fresh Water Research (NIFFR), Kainji;

- **Livestock-Related Research Institutes:** They are the National Veterinary Research Institute (NVRI) Vom, near Jos and Leather Research Institute of Nigeria (LRIN), Zaria;
- **Research Result Dissemination and Technology Transfer Related Research Institute.** The only institute here is the National Stored Products Research Institute (NSPRI), Ibadan.[8]

Agricultural research in Nigeria is said to have started formally with the establishment of a botanical garden in Lagos in 1898 by Sir Claude McDonald.[9] This garden was part of a network of gardens established under British rule, with a focus on the introduction of new crops. In 1903, the Forestry and Botanical Department, later known as Agricultural Department for Southern Nigeria, was created.[10] In 1912, this was divided into the two regions' departments resulting in the establishment of a department of agriculture for northern Nigeria and department of agriculture for southern Nigeria. With the amalgamation of Nigeria in 1914, the two departments were merged to form a new department of agriculture.[11]

Over time, some progress was made in terms of new research stations, more research personnel and more technical research programme that included plant breeding and plant pathology.[12] Further research continued to focus on export crops like oil palm, rubber among others. The forestry and veterinary departments were also established in 1920.[13] Thus, most of the research institutes were located in areas suitable for the production of theses export crops. It should however, be noted that this period of rapid export was brought to a sharp halt by the Great Depression of 1929, when world wide collapse in commodity markets brought severe reduction in Nigeria's export prices and temporary stagnation in export volume.[14]

Agricultural research was largely the domain of the local colonial government in Nigeria until the outbreak of World War II in 1939, when the British government sought for more active role in the promotion of sciences and technology in its colonies. This enquiry

was said to have led to the creation of several regional agricultural research organisations in West Africa to complement or partially replace existing facilities which were part of the West African Inter-territorial Research Organisation (WAIFRO).[15] Three of them: the West African Institute for Oil Palm Research (WAIFOR), the West African Institute for Trypanosomiasis Research (WAITR) and the West African Stored Products Research Unit (WASPRU), were sited in Nigeria in 1951.[16]

Until the introduction of 1954 constitution, which placed agricultural research on the concurrent list between the federal and regional governments, agricultural research in Nigeria had largely consisted of research and experimental sections of the defunct federal department of agriculture with headquarters at the Moor plantation (named after the British High Commissioner for Southern Nigeria, Sir Ralph Moor), and outstations at Lagos, Samaru, Umudike, Shika and Bedeggi.[17] During this period, the private sector had played a major role in the export crop research, especially on cotton. This was probably because agricultural research in Nigeria laid much emphasis on export crops – oil palm, cotton, groundnut, cocoa and rubber – all of which were needed by the British economy.[18]

With Nigeria's independence attained in 1960, the regional institutes were nationalised and the Nigerian Institute for Oil Palm Research (NIFOR), Nigeria Institute for Trypomiasis Research (NIFR), Nigeria Stored Products Research Institute (NSPRI) and the Cocoa Research Institute of Nigeria (CRIN) came to stand on their own. This development was said to have prompted the federal government to once again intervene in the 1960s in the re-organisation and expansion of the research institutes in the 1970s and the establishment of Agricultural Research Council of Nigeria (ARCN) in 1977.[19]

In 1977, the first ARCN, along with other sectional councils, was abolished, and the Nigerian Science and Technology Development Agency was established in its place by a statue to advise the federal government on matters relating to scientific research and

development.[20] Further changes came with the Research Institutes Establishment Order of 1980,[21] under which many research stations and departments were upgraded to national institutes. As a result of this, the research institutes underwent further significant re-organisation, including a review of their mandates as a part of the green revolution programme of the early 1980s. The changes in coordination were said to have continued under the military regimes of the 1980s and 1990s. However, in 1992, the need to re-align agricultural research to the Federal Ministry of Agricultural Science Departments along with the seventeen agricultural research institutes were formally returned to be fully integrated into the sector.[22]

In 1999, the Federal Military Government signed the Agricultural Research Council of Nigeria Decree No. 44 of May 26, of that year.[23] This development would probably have resulted in a hitch in the take-off of the activity as government focused its priorities on the implementation of the various presidential initiatives and the nation's special programme on food security.[24]

In December 2005, the presidential retreat on agriculture and food security was held at Kaduna, Kaduna State, where a weak linkage between research and agricultural production was identified as a major constraint to food production in Nigeria. At that retreat, a presidential research production was inaugurated with the terms of reference which included, but not limited to: identify existing constraints and limitations on linkages; recommend strategies to enhance public and private partnerships in research; propose strategies for enhancing linkages between research and production; identify roles of key stakeholders in improving linkages; and set target for research institutes as well as streamline their basic functions.[25]

In July 2006, the Presidential Advisory Committee (PAC) submitted its report to the presidential forum on improving linkages between research and production. In August 2006,

the presidential implementation committee on improving linkages between research and production was set up with deputy governors and others as members, while the Minister of Agriculture became the chairman. The presidential implementation committee on improving linkages between research and production was also inaugurated and mandated to, among other things: ensure the systematic and consistent implementation of all the recommendations of the PAC; and give quarterly report on the implementation/stages to the presidential forum.[26]

In November, 2006, the PAC presented its first quarterly report to the presidency with key recommendations on the immediate take-off of the Agricultural Research Council of Nigeria (ARCN) as the global best practice institutional arrangement for coordination and supervision of agricultural research institutes in Nigeria. Based on this, an executive secretary was appointed for Agricultural Research Council of Nigeria (ARCN) in November 2006.[27]

Mission Statement/Vision of Agricultural Research Institutes

The Mission Statement/Vision of the Agricultural Research Institutes in Nigeria was aimed at providing the necessary environment for the protection, processing and marketing of value added products from the institutes, for national food security, income generation, gainful employment and industrial development, among others.

The institutes have the national mandate for:

- research into the genetic improvement, production, processing, storage, utilisation and marketing of their research areas and in the case of the National Root Crop Research Institute, root and tuber crops of economic importance namely yam, cassava, potato, sweet potato, cocoyam, ginger, hybrid crops, disease resistance to crops, among others;

- research into the farming system in various zones of the country in order to improve the standard of living of poor farmers, to develop the farming system, livestock, and agro-forestry components into the curable crops production system;
- agricultural extension delivery to farmers in the nation's agro-ecological zones and liaise with the relevant federal and state ministries, industries and companies, NGOs (Non-governmental agencies) and other users of research results in collaboration with the National Agricultural Extension Research and Liaison Services (NAERLS); and
- provision of technical laboratory and ad-hoc training to farmers and agro-based industrialists on specialized areas such as rapid multiplication techniques and planning material.[28]

The Features of Agricultural Research Institutes in Nigeria

The various agricultural research institutes in Nigeria were established to provide the necessary environment for the production, processing and marketing of value-added products for national food security, income generation, gainful employment and industrial development. They were established as a theatre of innovation to increase farm productivity, small- holder income within the context of environmental sustainability, food- security, overall standard of living and macroeconomic stability. In this regard, therefore, research outputs might be measured in terms of the generation of new improved inputs.[29]

The features, therefore, reflect what these institutes are capable of achieving now and in the future. They include the following:[30]

- generation of technologies for boosting agricultural production;
- provision of new knowledge and new planting materials such as seeds; fertilizers and equipments;
- conducting research leading to improved hybrid crops;
- to cooperate with other organisations on matters of relevance;

- to liaise with other research bodies within and outside Nigeria carrying out similar research;
- to disseminate research findings;
- to cooperate with responsible ministry and relevant research committee in matters pertaining to policies and provisions; and
- to do all such things as appeared to be necessary, desirable, or expedient to carry out this function.

The Administration of Agricultural Research Institutes in Nigeria

The agricultural research institutes in Nigeria were established on regional background and regional stations[31] and were, therefore, associated with the development and application of agricultural sciences to agriculture in Nigeria. The formulation of agricultural policies was also regionally based and designed to realise the inextricable relationship between agricultural research and regional agricultural development in the various zones. While the main research stations were zonal, the institutes were comprised of several sub-stations to ensure extensive coverage of research findings and applications across the country. The largest of the sub-sections was the Sika Research Station, five miles north-west, on the Zaria-Funta road.[32] This station covered some 3,000 acres and was said to have started in 1928 as a government stock farm, intended to be used later for research on grasslands management and on animal production.[33]

Other important sub-stations established during the colonial period were situated at Mokwa (Niger State), Kano (Kano State), Baga in Borno State, Yendev in Benue State and Bakura in Zamfara State, among others. [34] The Mokwa research station was started by the Colonial Development Corporation in the post –World War II years and was subsequently taken over by the research division in the late 1950s. It was located 200 miles south-west of Samaru to the north of the Niger in the riverine province of Northern Nigeria.[35] It was

primarily concerned with the problem of the zone where it was located.[36] The Kano research station, lying 100 miles north-east of Samaru, served the needs of the northern districts and paid special attention to the problem associated with the cultivation of groundnut, millet and sorghum.[37]

Also, the formulation of agricultural policies for regional agricultural development was the responsibility of the department of agriculture under the directive of the Director of Agriculture. The director was assisted by the Assistant Director of Agriculture in various zones.[38] Both collectively ensured that all the research findings were experimented in the different sub-sections in order to identify areas of better yields and further cultivation in such regions. Thus, the agricultural research institutes in the various zones in Nigeria were organised to be responsible for carrying out researches in support of all aspects of the agricultural industry in Nigeria.[39]

The staffing of the agricultural research institutes went along with the staff training and re-training process of the agricultural department.[40] This was because, apart from the early staff recruitment by the institutes in the early years, the later staff were essentially the trainees or products of their training wing. The formation of the training ground for the institutes was conceived by the British as a panacea to the lack of suitably trained agricultural personnel in the country. [41]

From records, the initial recruited staff in the agricultural research institutes by the Agricultural Department was a botanist, who worked with the biological laboratory established in 1925.[42] He was said to have tested new strains of varieties of different crops which were produced and tested with some measure of success. The next staff employed was a chemist, who investigated the various factors responsible for the phenomenal increase in yields arising from farm yard manure. For instance, in the case of the Institute of Agricultural Research Ibadan, J.D Shepherd was appointed the principal of the Institute beginning from

December 1939, [43] and was also actively involved in the research activities of the institute throughout his stay. In other words, he was not only the head of the institute but also a staff. On his re-deployment, he was replaced by G. Brown, who headed and researched with the institute from December of that same year through the early 1950s before taking up an appointment as the Deputy Director of Agriculture in the Northern Provinces of Nigeria in 1958.[44]

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CHAPTER THREE

HISTORY OF THE NATIONAL ROOT CROPS RESEARCH INSTITUTE, UMUDIKE

Origin and Growth

The British colonial administration in Nigeria, especially from 1861, witnessed a paradigm shift from political conquest to agricultural development and considerable emphasis was placed on growth and mass production of cash crops. The first activity in this regard was the establishment of a model farm of the British colonial administration in 1898 at Ibadan, with the sole objective of rubber tree propagation and entire agricultural improvement.[1] The activities of the farm consequently increased to conducting research in agriculture.

In 1905, the British Cotton Growers Association (BCGA) acquired 10.35 square kilometres of land beside the model farm and merged it with the model farm to establish what was known as the Moor Plantation, Ibadan,[2] a name derived from the then British High Commissioner for Southern Nigeria, Sir Ralph Moor. The plantation's activities increased considerably, and along the line, they acquired experimentation station status with the responsibility of conducting research into cotton to feed the needs and demands of the British textile industry.[3] It would not be an overstatement to state that the Moor plantation was the origin of formal agricultural training in Nigeria,[4] and the headquarters of the Department of Agriculture, and much later, the home to a botanical laboratory in 1915,[5] alongside the establishment of the training wing (School of Agriculture) founded in 1921 by Mr. O. F. Faulkner, the then Director of Agriculture for Nigeria.[6] The training at the plantation had a wide range of coverage which was extended to other parts of West Africa in years to come. All these activities revolved around Ibadan; and perhaps this could be the reason why Ibadan at present is the home to about six research institutes in Nigeria, out of the seventeen institutes.

Plate 2: Administrative building at the NRCRI, 1923

Source: *C.O Chukwuleta field survey, 2017*

61

Plate 3: NRCRI Staff quarters, 1923

Source: *C.O Chukwuleta field survey, 2017*

62

The Moor plantation, then, served as an experimental farm for Nigeria, not only for the propagation of cotton but also to accommodate other crops. Thus, in order to achieve its full capacity, it extended its activities to other adjoining provinces including the Eastern Provinces where Umudike (a town close to Umuahia) was chosen as an agricultural research and training station. The probable reason for this development was that the plantation needed to establish provincial farms outside Ibadan where it could test-run its agricultural experiments as it had previously collaborated its research with the Department of Agriculture.[7]

From the foregoing, one can rightly assert that the history of the National Root Crops Research Institute, Umudike, may not be complete without bringing into focus the initial activities of the Moor plantation. The National Root Crops Research Institute, Umudike, is said to have assumed a provincial experimental farm status on 1st January 1923.[8] The initial activities of the Institute included acquisition of about 20 hectares (50 acres) of land, where work commenced with clearing , stumping and the actual crop planting of cotton seeds.[9] Over time, more lands were acquired, and by 1937 the total area occupied was 123 hectares (304 acres), out of which 41.3 hectares (102 acres) of land were devoted to experiments on annual crops, while 24.3 hectares (60 acres) were reserved for permanent crops, mainly oil palm.[10] Whatever results obtained from the crops on experimental stations were usually sent to the headquarters at the Moor plantation at Ibadan for final analysis.[11] At the beginning, a total of twenty-three staff worked at the Institute, comprising ten senior staff posted to the station from the parent institute, while thirteen were recruited from Umudike (mostly field workers).[12] By this time, a total of seven buildings were at the institute, two of the buildings served as the plant and the harvest office, while the other five buildings served as staff quarters for the staff that were posted from Ibadan.[13]

In the 1950s, some political changes took place in Nigeria resulting in the regionalisation of most government departments between 1954 and 1955.[14] Expectedly, this marked a turning point for the Umudike agricultural station. As a result, it came under the auspices of the Director of Agriculture for Eastern Nigeria with headquarters at Enugu in 1955.[15] This new development served the agricultural research needs of the Eastern Region.

Despite the said political changes that took place in the regions, the results of the experiment were still sent to Ibadan for analysis. This situation continued for a long time probably because of lack of experienced research officers who could give accurate interpretation of the results. In fact, it became more like a collaboration between the two institutes.[16] Over time, the School of Agriculture was established at the border land of the research farm. The school became part of the station, as it assumed the position of its training wing, giving short term and long-term training to the newly recruited staff and organising in-service trainings for the older staff. The school also helped to bring the station to limelight by training more research scientists. Apart from being the training wing of the station, the school was said to have registered about twenty five students in the first year of its inception.[17] This first group of students became agents of information dissemination. In addition to the new farming techniques experimented by the students at home, the farm gradually gained more prominence, especially around Ibeku and the environs.[18]

In 1956, the farm became known as the Eastern Nigeria Agricultural Research Station (ENARS),[19] and a subsequent merger of the school and the station in the same year, produced the Agricultural Research and Training Station (A.R.T.S).[20s]As expected, the station continued to increase and by 1960/61, it acquired an additional 165 hectares (407 acres) and was now referred to as the Eastern Farm; by 1965, when 122 hectares (300 acres) of land was acquired from the Olokoro district and was regarded as the western farm or Olokoro extension, thereby bringing the total average of the station to 309 hectares (1007

acres). The acquisition of swamp land on either side of the Umudike stream area of about 7.5 hectares (18 acres) was also made.[21]

With the additional lands acquired, numerous small plots experiments as directed by the Moor plantation were carried out. Also, the independence of the country from Britain in 1960 opened a new chapter for the Moor plantation to have a new look as well as other research stations.[22] Moreover, with the introduction of the 1962-1968 development plan, agricultural production activities were prioritised. Following this, the station was to be considerably developed through the loan agreement between the United States Agency for International Development (USAID) and the Eastern Nigeria Government. In the said agreement, the USAID was expected to provide funds for capital development to the tune of $2.622 million, while the regional government was to take care of recurrent costs estimated at 20 per cent of the capital cost of expansion.[23] By 1966/67, large quantities of commodities, stores, vehicles, equipment, among others, arrived from the United States, but unfortunately, the plan of development was truncated by the outbreak of the civil war in Nigeria.[24]

At the end of the civil war in 1970, it was discovered that in spite of the greatest care taken so that the station would not be ruined, most of the stock at the stores, hostels, classrooms, and scientific equipment built up at the station over the years had been lost or badly managed by the war.[25] The war had created a huge level of backwardness for the station, as several buildings, especially the residential quarters and laboratories, were stripped of fixtures and fittings as well as the major portions of the pre-fabricated buildings dismantled and carted away. [26] This scenario created a sense of loss to the workers who came back to their base after the war.[27] The state of ruins and loss of valuables was so disheartening.

As a result of the 12-state structure of the country, the station was inherited by the East-Central State Government, [28]which was as at 1970 trying to re-build the Igbo-speaking

area. The government's priority was on the re-construction of social infrastructure to its pre-war level with the insufficient fund at its disposal.[29]However, this situation did not last long until 26th January, 1971, when the station was fortunate to be honoured by a visit of the Head of State, General Yakubu Gowon, who was accompanied by the Administrator of the Eastern Central State, Mr. Ukpabi Asika.[30] During the visit, the head of state and his entourage were shown round the station to ascertain the extent of damage with the view of adding it to the list of the ongoing reconstruction programme in the state.[31]

The outcome of Gowon's visit and perhaps the visits of other government officials was made manifest on 1st April, 1972,[32] when the Federal Government took over the station and re-named it the Federal Agricultural Research and Training Station (F.A.R.T.S). The re-naming of the institute was said to have come in line with Gowon's post-war policy of the three R's Reconciliation, Rehabilitation, and Reconstruction.[33]

Perhaps, convinced that the re-vitalisation of the country's economy was largely dependent on agriculture through the agricultural stations, government thought it wise to harmonise its economic policies through the Agricultural Research Institute Decree No. 35 of 1973.[34] Arising from this, the station was promoted to the *defacto* rank of a research institute, which came under the Agricultural Research Council of Nigeria (ARCN). This was further solidified when the station became upgraded to a commodity research institute in 1975, through the Federal Government Agricultural Research Institute Decree No. 30 (Research Institute Establishment) Order 1975.[35] It was in the decree that the mandate of the Institute was clearly pronounced, be that as it may, NRCRI started operations under its news name in 1976.[36]

In 1980, the Institute was yet again transferred to the Federal Ministry of Science and Technology. In 1991, the Institute was brought under the Agricultural Research Council of Nigeria (ARCN) following an act to establish the Agricultural Research Council of Nigeria

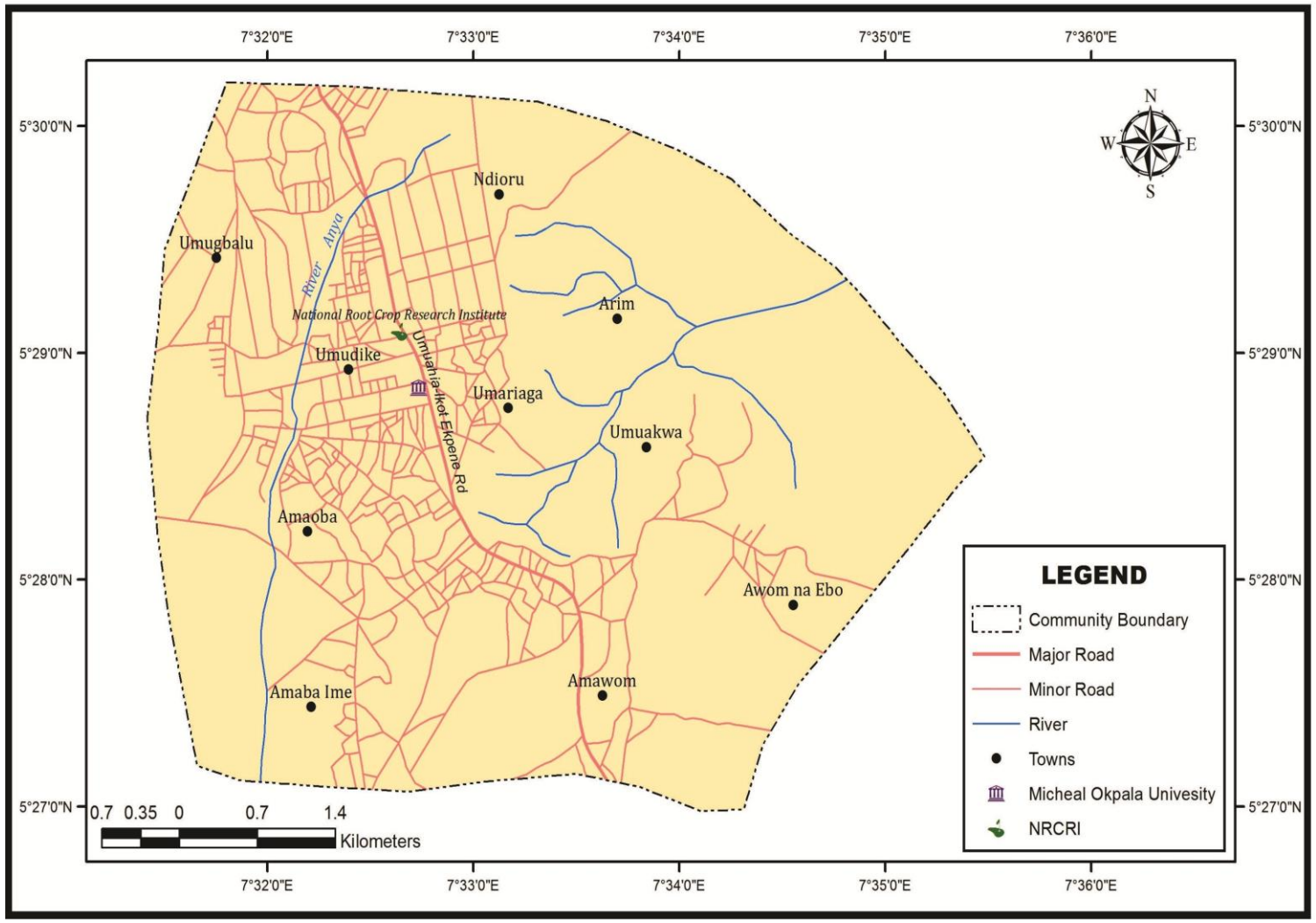
which provided for the establishment of research institutes by the Council. As a result of the further re-organisation of the research institutes in 1996, the Institute came under the Federal Ministry of Agriculture Water and Rural Development.[37]

Geography and Physical Features of the Institute

Location

The National Root Crops Research Institute has its headquarters at Umudike, a community in Ikwuano Local Government Area of Abia State, Nigeria. The community is surrounded by other neighbouring villages with which it shares common cultural beliefs. These communities include Umuariaga, Amaoba, Amawom, Nnono, Ndoro and Ahuwa.[38] According to an official document,"Umudike is located 8 kilometres off Umuahia Ibeku, 140 kilometres north off Port-Harcourt international airport, 135 kilometres south of the Enugu airport and 80 kilometres east of the Owerri airport. It is situated on latitude $5^{1}/_{2}{}^{0}$N and on longitude $7^{1}/_{2}{}^{0E}$ and 122m (400ft) above sea level. The Institute is divided into two by a trunk B road which runs from Umuahia – Ibeku Township to Ikot-Ekpene where it joins a trunk A road from Aba to Oron on the Calabar route."[39]

MAP OF UMUDIKE, SHOWING THE LOCATION OF NRCRI



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Climate

The climate of Umudike is typically of the humid tropics with fairly uniform temperatures throughout the two seasons (dry and rainy) each year. The rainy season, which usually starts from early March and ends in October, is characterised by clouds driven by light winds from the Atlantic ocean, relatively constant temperatures, frequent rains and high humidity.[40]From May to September, the rainfall is quite high reaching its peak in September. This probably could have accounted for the choice of the location of the station, during the season, although sunny days are fairly common as most of the rains fall at nights. Hours of sunshine per day are lowest during the peak of the rains. From early November, when the dry season starts, the weather shifts to become the dusty harmatan bringing the drier air from the Sahara. The season notably dries up with very little rainfall, hotter days, cooler night and lower humidity, ending in February. A meterological station was maintained at the Institute and observations were made on rainfall, air and soil temperatures, relative humidity, sunshine, wind, velocity and evaporation.[41]

Topography/Soil

The soils were derived from semi-consolidated sand and sandy clay deposits which tended to grade into a top sequence following the occurrence of the natural ridge running across the station in a west-eastern direction with the land sloping towards the northern and southern boundaries. Towards the western half, the ridge was directed by the Qua-Ibo stream into whose narrow basin the ridge tended to phase out. According to Mr U.K.Nnodim,

"The soil in the research Institute consists of well-drained red to yellowish sandy loamy to sandy clay occurring at the summits and upper slopes of the ridges, with very deep homogenous profiles, with a slightly textural B horizon and have been differentiated into types A_1 and A_2, based essentially on the texture of the top soil."[42] Type A1, which occurs on the summits, has 356 – 457mm (14-18 inches) of greyish brown coarse loamy sand tops in

contrast to A_2 which has only 127 – 178 mm (5-7 inches) of this horizon and occurring at the upper middle slopes. This means that the soil at the Institute is a very good loamy soil.[43]

Funding of the Institute

Funding of the research institute as well as other sister institutes in the country was initially a collaborative effort between the federal, state and private sectors. However, starting from 1975, the federal government assumed full responsibility for agricultural research funding, based on the following reasons: the amount of funds released by the federal government had consistently fallen short of the research institutes' budget; there has not been a clear line of distinction between funds for salaries and research. Thus, funds released were allocated primarily for payment of salaries and whatever remained went for research, especially in older research institutes which possessed heavy overhead cost; and in addition to the inadequacy and instability of research funding, funds were often released untimely. This situation introduced uncertainty in the funding process.[44]

Generally, the 1980s saw some level of instability in the funding of the institutes. This poor funding position led to the inability of the Umudike institute to release downstream farm income increases, rural employment, reduction in food prices and rural poverty. Since the 1990s, the Institute has been receiving both recurrent and capital budgets on a monthly basis, leaving virtually no space for long term research investment, and as a result of the federal government inability to fully fund research institutes in Nigeria, donor agencies came and filled the gap.[45]

With the donor support, however, the Institute was able to purchase laboratory and field equipment, as well as pay a proportion of staff salaries.[46] The World Bank was the largest supporter of agricultural research and development programmes at the Institute upto 1999. The Institute was said to have received grants from private foundations like the

Rockefeller Foundation(2000), Getsby Trust Foundation(2005) and the International foundation for Science (2008), and in 2010, Bill and Melinda Gates Foundation initiated funding for the Institute which, until the time of writing up of the research in 2018, was still running.[47]

Experimental Farm and Crops

The experimental design used in the 1930s was the design known as *faulkners* strips. Over the years some improvements were made in the designs. According to U.C. Ukawundu:

> *Through the use of this design, the experimental fields were divided into 10.12 hacter ($^1/_2$ acre) strips, known as plots which were long and narrow. A control treatment usually a local or a standard practice, was placed in alternate plots, while a new treatment tested against the control, was placed between the control plots. In fact, there was no randomization in the placement of treatments. The means of the adjustment control plot was compared with the mean of treatment plots and only very large differences were judged significant.*[48]

By the 1940s, there occurred significant changes, from the early designs. Simple randomized designs such as *Randomized Block* and *Latin Square* were gradually introduced to replace the former design.[49] However, from the 1970s, more complicated experimental designs were used to test multiple factors simultaneously. During this period, data collected were analysed in such a manner that the fallibility of estimates and conclusions could be assessed by means of inductive reasoning based on the mathematics of probability. The experiments were thus conducted on a variety of crops such as yams, cassava, rice, cow-peas, sweet potatoes, fibre crops and so on.[50]

Research Experiments and Findings

Over time, experiments and findings passed through phases. As a result of this development, most of the early experiments on the farm were conducted with the objective of finding a system of cropping which would include green manures in order to maintain, and if possible, improve the fertility of the soil. One of such experiments was a six-year trial

rotation set up in 1924.[51] This rotation was planned to test the cropping capacity of the soil without the aftermath of loss of fertility by including a three-year green manure crop (*macuna*), followed by yams, maize and cassava. This rotation was then compared with the local system of a four-year bush fallow followed by a two-year cropping.[52] This experiment involved cover-crop experiment from (*macuna utilization dolichos lablab)*, and lasted till 1927.

Apart from the above early experiments at the research institute, others include *crotolaria* and *calopogonium* (1928-1932): *Tephorsia candida* and *mimosa invisa* (1934 - 1935). Organic manure (farm yard manure and compost) was used to experiment within the period of 1937 – 1938. Liming (use of lime) was used for experiments in the 1940s; from 1960 – 1972 experiments were carried out on fertilizers.[53]

From 1976, fertilizer practice became the farming system and cultural practice, it involves the application of a compound granules fertilizer Nitrogen Potassium Calcium (N.P.K) 1010.20 at the rate of 336/kg/ha for either yams or cassava.[54]

Samples of Various Trials Embarked on by the Institute

- Experiment No. 4.3(76), 50 Varieties of sweet potato were tried to ascertain the effect of mixed cropping and relative planting rates.
- Experiment No.2.3 (76), Ai Umudike, 30 varieties were tried for relative planting rates on sweet potato.
- Experiment No 3.1 (77), Cii Ugwuoba, 50 varieties of cassava tried for late planting.
- Experiment No 1.3 (77), Umudike, Cocoyam Time of planting trial
- Experiment No 3.6 (78), Chemical weed control on cassava inter-planted with maize at Umudike.
- Experiment No. 4.2 (78), Biii 10 top cassava selection regional trial at Otobi.
- Experiment No 4.4 (79), C iii 50 varieties late trial at Otobi.

- Experiment No. 4.6 (79), Di 10 top cassava selection, late trial at Umudike
- Experiment No 5.2 (80), Bj Ten top cassava selection, late trial Obior.
- Experiment No 5.3 (80), Ai. Cassava regional late trial of 50 varieties at Offa farm.
- Experiment No 1.2 (81), Bv 10 top cassava selection at Umunede.
- Experiment No 1.5 (81), Bi Ten top cocoyam selection at Umudike.
- Experiment No 2.8 (82), D iii 10 top cocoyam selection late trial at Otobi.
- Experiment No. 2.9 (82), D ii 10 top yam selection late trial at Ugwuoba.
- Experiment. No .2.3 (83), Ci 50 varieties late yam trials at Umudike.
- Experiment on field E-6 (strip 4), (83), Effects of mixed cropping and relative planting dates on the performance of sweet potato at Umudike.
- Experiment on field E-7, (84), Effect of method of application and late planting phenomenon on the establishment of cassava farm at Umudike.
- Experiment No 3.5, (84), Ci zonal trial of 10 varieties at Umudike.
- Experiment No 3.1 (85), Time of planting and harvesting of sweet potato at Umudike.
- Experiment No P.5.1. (85), Chemical Control of Sweet potato weevil at Umudike.
- Experiment No 3.3 (86), Cocoyam- Mulching Experiment at Umudike.
- Experiment on field E-8, (87), effects of the three sources of potassium *KCL, KCL t5* and *K2 504* on the yield and uptake of potassium by Cassava plants at Umudike.
- Experiment No 10.2 (87), (Cassava nutrition II)

"Experimental Trials Embarked on by N.R.C.R.I, Umudike from 1976–1987",

Source: Planning Division: National Root Crops Research Institute Umudike, 1980, 1-2.

Plate 4: NRCRI Central Laboratory

Source: *C.O Chukwuleta field survey, 2017*

National Mandate of the National Root Crops Research Institute

The mandate of the National Root Crops Research Institute includes the following:

- research into genetic improvement, production, processing, storage, utilisation and marketing of root and tuber crops of economic importance namely, yam, cassava, potato, sweet potato, cocoyam, rizga and tumeric.
- research into the farming system of the South-east agro-ecological zone of Nigeria in order to improve the standard of living of the resource poor farmers. The zone covers Abia, Akwa Ibom, Anambra, Bayelsa, Cross River, Ebonyi, Enugu, Imo and Rivers State. Included in this farming system mandate are the execution and integration of fisheries, livestock and agro-foresting component into the arable crop production system.
- agricultural extension delivery to farmers in the South-east agro-ecological zone in liaison with relevant federal and state ministries, industries and companies, NGOs (Non-governmental organisations) and other users of research results in collaboration with the National Agricultural Extension Research and Liaison Services (NAERLS).
- provision of technical, laboratory and adhoc training to farmers and agro-based industrialists on specialised areas such as rapid multiplication techniques of root and tuber planting materials.[55]

Training Wing

The Federal College of Agriculture, Ishiagu, in Ebonyi State, is the training arm of the Institute. The college was re-located in 1993 and it has since been training students at the National and Higher National levels thereby providing reasonable manpower for the country at large. The Institute and the training arm are known to have only one governing board. Prior to 1993, the Institute's Executive Council was known to be in charge of the college. However, with the autonomous status, the college now has a rector who directly oversees its day-to-day running.[56]

In the recent past, the school has also organised short term courses to train farmers and extension agents.[57] At present, it organises the following courses: preliminary National Diploma (Pre-National Diploma in Science and Technology), National Diploma (HND) in Crop production, Pest-management Technology, Agricultural Extension and Management Animal production ,horticulture and landscape Technology, and many more others.[58]

Collaboration

The National Root Crops Research Institute, Umudike, is known to collaborate with research and donor agencies at the international, regional, national and local levels. The collaborators include the International Institute for Tropical Agriculture (IITA), Ibadan; Bill and Melinda Gates Foundation, United States of America; Food and Agriculture Organisation (FAO), Rome; International Atomic Energy Agency (IAEA), Austria; International Plant Genetic Resources Institute (I.P.G.R.I), Rome; International Centre for Tropical Agriculture (C.I.A.T), Columbia; United States Agency for International Development (USAID), United States of America; International Laboratory for Tropical Agricultural Biotechnology (I.L.T.A.B), United States of America; and the National Centre for Genetic Resources and Biotechnology (NAGRAB), Abuja. Others include Shell Petroleum Development Cooperation (SPDC), Niger Delta Development Commission (NDDC), the nine Agricultural Development Programmes (ADPs) in the South-east agro-ecological zone of Nigeria. The faculties of Agriculture in the South-East Universities such as Michael Okpara University of Agriculture, Umudike; Federal University of Technology, Owerri; University of Calabar, Calabar; University of Uyo and University of Nigeria, Nsukka. Also, included are the West and Central African Regional Development (WECARD), Strategic Food Research (SFR) Abuja, NGOs, as well as the World Bank and the International Fund for Agricultural Development (IFAD).[59]

Sub-Stations of the National Root Crops Institute, Umudike

Generally, the objectives of establishing the sub-stations include but not limited, to increase production of major crops in Nigeria by selection and breeding of high yield and disease resistant varieties of yam, cassava, cocoyam and sweet potatoes; determine the environmental adaptability of these crops and to breed varieties suitable for different ecological zones in which they are grown; provide planting materials of the selected varieties of these crops wherever possible; assess the acceptability of selected varieties, and assess the existing agronomic practice and determine optimum cultural conditions for the growing of these root crops.[60]

Over the years, the sub-station has worked on the improvement of cassava, yam, sweet potatoes and cocoyam, first by embarking on the collection of varieties of these crops from within and outside Nigeria and building large gene pools from which breeding and selection for various desirable characters were organised. The selected varieties and hybrid were tested for yields, acceptability, pest and disease resistance crops in selected centres located in chosen ecological zones in the country. For instance, in 1967, work was concluded on some cassava variety tests and the unit came up with the recommendation of 60444, 60447, 60506 and 53101 varieties for distribution to farmers in various parts of Nigeria on the basis of their consistent high yields, adaptability, drought resistance and high quality products.[61]

Locations of the sub-stations[62]

- North-central Zone: Kuru, Plateau State.
- North-central Zone: Nyanya, Nasarawa State.
- North–Central zone: Otobi, Benue State.
- North–Central zone: Maro, Kaduna State.
- South-West zone: Iresi, Osun State.
- South-east zone: Igbariam, Anambra State.

Organisational Structure of the Institute

The National Root Crops Research Institute, Umudike, is organised in such a manner as to enable it fulfil its national mandate. It is administratively supervised by a governing board which is accountable to the Minister of Agriculture and Rural Development. The board is responsible for the running of the Institute. The executive director is responsible for the day-to-day running of the Institute. The director is assisted by assistant directors and heads of divisions who constitute the Institute's Management Committee (IMC).[63]

The Institute is structured into divisions with programmes and units for efficient and effective management. These divisions and their programmes are as follows:

Root Crops Research Division: This division normally researches into cassava, sweet potato and other root crops programmes.

Tuber Crops Research Division: It researches into yam, potato, turmeric and cocoyam.

Farming System, Research and Extension Division: The Farming Research System, Extension Services and Post-Harvest Technology Programme comprised: Planning, Monitoring and Evaluation

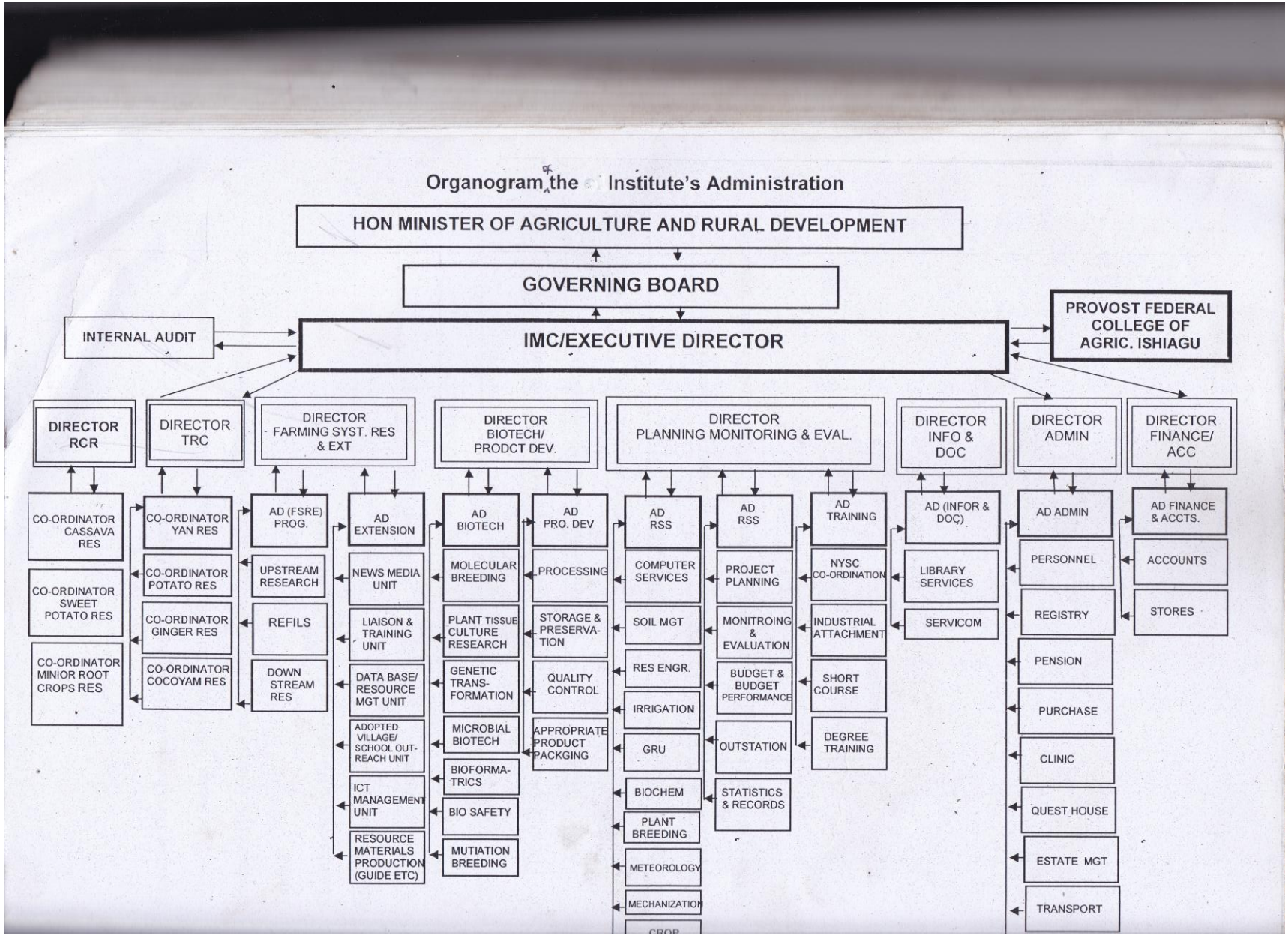
Research Support Services: The services include; Biotechnology, Irrigation, Bio Chemistry, Computer/Statistics/ Meterology, Soil and Water Management, Garri processing, Genetic Resources, Plant Protection, Plant Breeding and Research Engineering.

Information and Documentation: This takes charge of Library Information and Documentation.

Finance and Account

Administration.[64]

Below is the diagram showing the organogram of the institute's administration.


Organogram of the Institute's Administration
HON MINISTER OF AGRICULTURE AND RURAL DEVELOPMENT
GOVERNING BOARD
INTERNAL AUDIT
IMC/EXECUTIVE DIRECTOR
PROVOST FEDERAL COLLEGE OF AGRIC. ISHIAGU
DIRECTOR RCR
DIRECTOR TRC
DIRECTOR FARMING SYST. RES & EXT
DIRECTOR BIOTECH/ PRODCT DEV.
DIRECTOR PLANNING MONITORING & EVAL.
DIRECTOR INFO & DOC
DIRECTOR ADMIN
DIRECTOR FINANCE/ ACC
CO-ORDINATOR CASSAVA RES
CO-ORDINATOR SWEET POTATO RES
CO-ORDINATOR MINIOR ROOT CROPS RES
CO-ORDINATOR YAN RES
CO-ORDINATOR POTATO RES
CO-ORDINATOR GINGER RES
CO-ORDINATOR COCOYAM RES
AD (FSRE) PROG.
UPSTREAM RESEARCH
REFILS
DOWN STREAM RES
AD EXTENSION
NEWS MEDIA UNIT
LIAISON & TRAINING UNIT
DATA BASE/ RESOURCE MGT UNIT
ADOPTED VILLAGE/ SCHOOL OUT-REACH UNIT
ICT MANAGEMENT UNIT
RESOURCE MATERIALS PRODUCTION (GUIDE ETC)
AD BIOTECH
MOLECULAR BREEDING
PLANT TISSUE CULTURE RESEARCH
GENETIC TRANS-FORMATION
MICROBIAL BIOTECH
BIOFORMA-TRICS
BIO SAFETY
MUTIATION BREEDING
AD PRO. DEV
PROCESSING
STORAGE & PRESERVA-TION
QUALITY CONTROL
APPROPRIATE PRODUCT PACKGING
AD RSS
COMPUTER SERVICES
SOIL MGT
RES ENGR.
IRRIGATION
GRU
BIOCHEM
PLANT BREEDING
METEOROLOGY
MECHANIZATION
AD RSS
PROJECT PLANNING
MONITROING & EVALUATION
BUDGET & BUDGET PERFORMANCE
OUTSTATION
STATISTICS & RECORDS
AD TRAINING
NYSC CO-ORDINATION
INDUSTRIAL ATTACHMENT
SHORT COURSE
DEGREE TRAINING
AD (INFOR & DOC)
LIBRARY SERVICES
SERVICOM
AD ADMIN
PERSONNEL
REGISTRY
PENSION
PURCHASE
CLINIC
QUEST HOUSE
ESTATE MGT
TRANSPORT
AD FINANCE & ACCTS.
ACCOUNTS
STORES

Executive Directors and Staffing for the study period

The tables below may help the reader to better understand the various executive directors of the Institute and the periods they held offices as well as the staffing over periods:

Table 1

Chief Executive Directors of the Institute, 1975-2014

S\N	Name of Director	Duration
1	Dr. C.K Obihara	1st June, 1975 to 20th June 1976
2	Dr. E.C. Onochie	15th July 1976 to 11th May 1979
3	Dr. L.S.O. Ene	1st may, 1981-14th February 1994
4	Dr. O.O. Okoli	15th February 1994 to 25th November 1998
5	Dr. M.C Ikwelle	December 1998 to November 2002
6	Dr. Kenneth I. Nwosu	23rd December 2002 to October 2011
7	Dr. J.C. Okonkwo	November 2011 to Date

"National Root Crops Research Institute Past and Present Executive Directors,"

Source: Planning Division National Root Crops Research Institute Umudike, Abia State, 2017, 2.

Table 2

Senior Staff Strength as at 1976

Position held	**No**
Director	1
Assistant Director	1
Chief Scientific Officer I	1
Principal of School/ Assistant Chief School Officer I	1
Principal Research Officer	6
Senior Research Officer	16
Senior Agricultural Officer	6
Research Officer I	15
Agricultural Officer	4
Research Officer II / Pupil Research Officer	17
Pupil Research Officer	21
Agricultural Officer	11
Chemist 1	1
Principal Technical Officer 1	2
Principal Agricultural Superintendent	2
Senior Technical Officer	2
Senior Agricultural Superintendent	3
Librarian	I
Higher Agricultural Superintendent	1

Higher Technical Officer	4
Science Laboratory Technologist	I
Agricultural Superintendent	39
Technical Officer	2
Superintendent of Press	I
Senior Executive Office G.D	4
Confidential Secretary	I
Senior Accountant	I
Senior Executive Officer A (S)	I
Executive Officers Account	4
Stores Officer	1

"Senior Staff Disposition as at 1976."

Source: Administrative and Planning Division, National Root Crops Research Institute Umudike, Abia State 1976, 1.

Table 3

Junior Staff Disposition as at 1976

Assistant Executive Officer	3
Assistant Executive Officer Account	3
Assistant Stores Officer	1
Assistant Stock Verifier	1
Confidential secretary	2

Agriculture superintendent TRG	17
Assistant Technical Officer	8
Foreman	8
Assistant Library Officer	1
Photographic Assistant	2
Assistant Laboratory Technologist TRG	2
Agricultural Assistant	36
Senior Motor Driver/Mechanic	3
Senior Tractor Driver/Mechanic	1
Senior Technical Assistant	I
Senior Store Keeper	2
Senior Clerical Officer	6
Stenographer	4
Chief Typist	4
Chargeman	22
Lab Technician	13
Printer	1
Senior Craft Man / Mechanic	1
Clerical Officer	31
Senior Typist	4
Senior Telephone Attendant	1
Store Keeper	4

Library Assistant	3
Motor Driver/mechanic	21
Tractor Mower – mechanic	10
Senior Technical Assistant (TRG)	13
Senior Stock man	2
Meterological Assistant	1

Details of staff strength are provided in the appendix

End Notes

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5. K. Flaherty, G.B Ayoola, J. Ogbodo J. and N. Beintema, "Nigeria: Recent Development in Agricultural Research, Agricultural Science and Technology Indicators – Agricultural Research in Nigeria," *Journal of Agricultural and Rural Development* 6 (1) – 3.
6. Flaherty, Ayoola, Ogbodo and Beintema, "Nigeria: Recent Development in Agricultural Research,…" , 4.
7. E. E. Onochie, 80 years, retired Executive Director, interviewed in his house at Onitsha, Anambra State, 20/06/17.
8. L.S.O. Ene, 80 years, retired Director, interviewed in his house at Uwani, Enugu, 30/06/17.
9. L.S.O Ene, personal interview, 30\06\17.
10. Ukpabi Joseph Ukpabi, 64 years, Acting Director, interviewed in his office at the National Root Crops Research Institute Umudike, 24/03/17.
11. O. C. Aniedu, 63 years, Deputy Director Planning, interviewed in his office at the National Root Crops Research Institute Umudike, 24/03/17.
12. Alex Merendo, 90 years, retired public servant, interviewed in his house at Ndume, Ikwuano Local Government Area, 08/07/16.

13. Alex Merendo, personal interview, 08\07\16.

14. L.S.O.Ene, personal interview, 30\06\17.

15. L.S.O.Ene, personal interview, 30\06\17.

16. O.C. Aniedu, personal interview, 24\03\17.

17. K.U Ololoh, 89 years, retired Principal School of Agriculture, Umudike, interviewed in his house at Umuahia, 15/08/16.

18. K.U Ololoh, personal interview, 15\08\16.

19. E.E. Onochie, personal interview, 20\06\17.

20. K.U Ololoh, personal interview, 15\08\16.

21. G.U Asumugha and E.O.Mbanaso, *Guide to Umudike Agricultural Research and Training Station, Federal Agricultural Research and Training Station* Umudike,(Umuahia: Ibeku and sons publishers, 1976), 5.

22. Asumugha and Mbanaso, *Guide to Umudike Agricultural Research and Training Station,* … 6.

23. Asumugha and Mbanaso, *Guide to Umudike Agricultural Research and Training Station,* … 6.

24. Asumugha and Mbanaso, *Guide to Umudike Agricultural Research and Training Station,* … 7.

25. G. O. Ekeledo, 85 years, retired public servant, interviewed in his house at Umuariaga village Ikwuano Local Government Area, Abia State, 08/07/17.

26. K. U Ololoh, personal interview, 15\08\16.

27. K. U Ololoh., personal interview, 15\08\16.

28. K.U.Ololoh, personal interview, 15\08\16.

29. T.O. Ekeledo, The reader may also see Dan O.Chukwu," Development, Planning and the Nigerian Economy: An Appraisal of the First East-Central State Development Plan, 1970-1974," *Confluence Journal of Jurispundence and International Law*, vol.4 No. 2, 2011, p 99-111.
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32. Asumugha and Mbanaso, *Guide to Umudike Agricultural Research and Training Station* ... 6.
33. Alexander. A. Madibo, *The Nigerian Revolution and the Biafran War*, (Enugu: Fourth Dimension Publishers, 2000), 187.
34. Federal Government Agricultural Research Institute Decree No.30, Research Institute order 1975, Annual Volume of the laws of Nigeria 1975.
35. Federal Government National Science and Technology Act No.18, National Science and Technology Act 1980, Annual volume of the laws of the federation of Nigeria 1980.
36. E.O. Onochie, personal interview, 20\06\17.
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CHAPTER FOUR

CHANNELS OF INNOVATION DISSEMINATION IN THE INSTITUTE

It may sound a truism that innovations of agricultural research institutes cannot be explained by a linear approach but through a system approach. Innovation is the result of a process of networking, interactive learning and negotiation among a heterogeneous innovation set of actors for distribution of benefits.[1]

An innovative system usually involves a network of organisation, enterprises, as well as individuals who are focused on evolving new products, new processes and new forms for economic benefits. In the case of our study Institute, the individuals concerned were used to interact and share their visions and passions.[2]

The National Root Crops Research Institute, Umudike, identified linkages through which its innovations are disseminated. These included the following:

Farmer Trainer Trainees;

Cooperative Societies;

Community-based Groups;

Agricultural development programmes;

Adopted village scheme; and

Adopted School out-reach Scheme.[3]

Below are the details of the above outlines:

Farmer Trainer Trainee

The Institute introduced this approach in 1982 to facilitate technology adoption by farmers.[4] A farmer trainee was a farmer selected through two processes, primarily, through a group of volunteer farmers in the community in partnership with the Institute volunteer to disseminate research innovations through their farm activities. One person from this group was selected a trainer trainee by the research scientist in charge of the group and presented to the group[5]. The trainee received free training from the research scientists which include practical demonstrations on his farm for eventual re-training of the group members. The farmer trainee played vital roles in mobilisation, training fellow farmers, hosting demonstration plots, bulking and distribution of planting materials, disseminating crop-based technologies and integrated soil fertility management options. The trainer-trainee shared his knowledge and experiences as well as conducted experiments which was demonstrated on his farm by the research scientist assigned to the group.[6]

Secondly, a group of farmers that partnered with the Institute chose an active member to represent them at the Institute. They were trained by the research officers at the Institute on technologies and innovations. Their duties included conducting training on farms with demonstration plots, schedule fortnightly meetings and visits organised by the research scientist, who either visits the farmers or gives the farmer trainee individual training. These farmer trainees also led in mobilising farmers to attend group activities such as training or demonstration sessions, in hosting demonstration plots and also helped in linking farmers to seed sources and distributed improved seeds and planting materials to other group members.[7]

Plate 5: Farmer-trainer-trainee by the Institute

***Source:** . I.W Okorie survey, 2016*

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The Institute also organises periodic lectures, seminars on improved varieties and improved farming techniques, cassava stem cutting, cassava multiplication, yam and cocoyam minisett technologies and many others.[8] The trainee was made to train the other farmer group members. It is on record that the Institute has more than fifty trainees working for it.[9]

The trainees were made to give feedback to the Institute through the research scientists assigned to them; the feedback was normally on the basis of the level of adoption of each technique presented; its problems and merits for possible ways of improving them.[10] The trainee trained the farmers on a continuous basis whenever the need arose; they also determined the contents of the topic to be taught; topics were determined on the nature of farmers' constraints including those with poor crop yields to low soil fertility demanding training on ways to improve soil fertility and new technology introduced by project farmers.

This approach facilitated information dissemination and reached a larger number of farmers in communities at low cost through multiplier effects that enabled farmers to adopt and innovate, make better decisions and provide a feedback to researchers. This implied that the farmers were used as ad-hoc trainers.

Cooperative Societies

The use of cooperative societies was said to have first been introduced in the Institute in February 1990. It involved collaboration of the cooperative societies and the Institute.[11] These societies were made to receive periodic training on new innovations and technologies from the research scientist supervisors.

Plate 6: Cooperative Society Training by NRCRI

Source:. *K.U Nwanguma survey, 2016*

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The Institute organised training programmes, which took place at the launch of a new technology or innovation, were aimed at creating awareness and possible adoption. It also organised workshops twice yearly on improved farming techniques, improved methods of fertilizer application, stem cuttings, yam and cocoyam minisett technology and many others.[12]The improved planting materials were acquired in bulk and consequently re-distributed to members at reduced prices. It is also said that research scientists were provided as monitors and supervisors for the on-ground activities at the members' farms; identified problems were discussed at the next workshop and training.[13]

Below are names of some cooperative societies that registered with the Institute

Table 4

Cooperative societies and extended techniques in collaboration with the extension research programme 1990-2000

S/N	Name of co-operative societies	Techniques extended	Yearly attendants
1.	Ndiokwu Cooperative Society	Cassava improved varieties	12
2.	Alilionwu Cooperative Society	Orange fleshed sweet potato	10
3.	Umeme-nadim Cooperative Society	Planting techniques and recommended spacing for cassava	6
4.	Aladinma Women Cooperative Society	A pro-vitamin A variety	15
5.	Udebiuwa Women Cooperative Society	Cassava stem multiplication technique	8

6.	Obiwuru Garri Processing Cooperative society	Multiplication method of cassava cutting using 2 and 3 nodes	16
7.	Nwannedinamba Cooperative Society	Cassava stem multiplication techniques	13
8.	Iheonunaekwu Cooperative society	Yam minisett technology	10
9.	Cassava Farmers Cooperative Society	Cassava stem multiplication technique	13
10.	Osodieme Cooperative Society	Cassava stem multiplication technique	10

Source: Compiled by the researcher from field work, 2017.

From the above table, it could be deduced that ten cooperative societies registered with the Institute as at the time of the research.

Community-based Organisations

Community-based groups are made up of people that organised community- based services. They were agents of innovation, dissemination of the Institute's activities and extended their services to them in order to improve their crop production. This idea was conceived in 2002. The Institute partnered with donor agencies in carrying out this programme.[14]

The Institute was said to have developed yam minisett technology which was extended to yam farmers in the Middle – Belt states of Nigeria in collaboration with Conference des Responsibles de Recherche Agronomique Africans(CORAF) and West and Central African Regional Development(WACARD).[15]The farmers beneficiaries of the programme were zoned and included those in Zakibiam, Markurdi, Katsina-ala, Otobi all in Benue State and Idah in Kogi

State.[16]The technologies demonstrated included the following: selection and identification of healthy seed yams; proper cutting of the yam minisett; seed dressing and treatment with recommended chemicals *(Basudin and mancozeb);* proper planting method for the yam minisett; plant spacing and optimum plant population (25cm apart); staking; weeding and application of herbicides.[17]

Apart from the foregoing, cocoyam minisett was said to have been extended to major farmers in the Anambara, Enugu and Delta areas. The Institute's dissemination approach was extended to the Ikwo group comprising Obeagu, Ekeke and Nduju Echara communities -all in Ebonyi State.[18] Farmers were also trained on the production of turmeric rhizomes using mother rhizomes, its processes from primary and secondary rhizomes. Thereafter the community-based groups introduced other crops of the Institute in addition to turmeric.[19]

The table below may help the reader to appreciate the involvement of the communities in the exercises**:**

Table 5

Community-based organisations trained on Turmeric Production and Processing and attendants 2000- 2014

S/N	**Name of Organisation**	**Attendants**
1	Obeagu Eleke Farmers Multi-purpose Cooperative Limited	10
2	Jeopon Farmers Multi-urpose Cooperative Limited	15
3	Ebo Ekpa Farmers Multi-purpose Cooperative limited	19
4	Egwurugwu Group Farmers Association	10

5	Ifunanya Women Farmers Association	18
6	Obinwanne Farmers Association	10
7	Egojionu Farmers Association	18
8	Igwebuike Farmers Association	15
9	Ogbo egwudinagu Age Grade	10
10	Ohangelode Age Grade	10
11	Ogbo Igidenyi Age Grade	7
12	Ogbo Ezumezu Age Grade	10
13	The Lord's Chosen Charismatic Renewal Ministries	6
14	Living Faith Chapel	10
15	Deeper Life Bible Church	9
16	Presbyterian Church	30
17	Christ Apostolic Church	8
18	St. Michael's Catholic Church	20
19	Watchman Catholic Charismatic Renewal Church	7

"Local organizations as agents of innovation extension,"

Source: National Root Crops Research Institute, Annual Reports, 2000- 2014.

The above table shows some community-based organisations that were identified and sensitised on the training on tumeric production and processing and their attendance from the Ikwo group of Ebonyi Central Agricultural Zone. From the table, a large number of people participated in the training and readily accepted rhizomes distributed to them for multiplication.

Plate 7: Community Based Group Training by NRCRI

Source: N.C Ezebuiro survey, 2014

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Interestingly, the womenfolk were part of the community groups that partnered with the Institute to disseminate their innovations on improved varieties. From time to time, women leaders partnered with the Institute to organise trainings for women in their communities. By August 2010, for instance, the Institute organised trainings and rural empowerment programme for women. Also, in 2010, the Agbobu women of Mbato autonomous community of Imo State were trained on value addition to roots and tuber crops. About three hundred and seventeen women were said to have been trained on cassava cutting, multiplication and planting.[20]

Apart from the above women group, the Institute's resource persons demonstrated new farming techniques, improved varieties, current method of fertilizer application and modern farming techniques in 2012 to women of Amachara community in Orlu Local Government Area of Imo State.[21] Other women group's who benefited from the Institute's innovations training programme between 2013 and 2014 included the Ndagbo women group; Umuohiri women group; Ngodo women group, all in Abia State and many others.[22]

Plate 8: Women Training by NRCRI

Source: *G.N Asumugha survey, 2012*

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The table below may help the reader to further appreciate these innovative activities explained above:

Table 6

Dissemination of information to women groups by the Institute

S/N	Women Group	No	Technologies Extended
1.	Ndagbo women group	20	Improved cassava varieties
2.	Amachara women group	115	Improved cassava varieties
3.	Umuohiri women group	20	Umucass 37 (pro-vitamin A)
4.	Ngodo women group	25	Tme 419, Tms 98/058, NR8082
5.	Amapu/Umuokwu women group	15	Multiplication of cassava
6.	Methodist women group	35	Stem cutting using 2 and 3 node.
7.	Agbobu women group	317	Orange fleshed sweet potato NRSP/051022

"Women as Agents of Agricultural Development"

Source: Compiled by the researcher from the National Root Crops Research Institute Annual Reports, 2000 - 2014.

The table indicates that the dissemination of the Institute's improved technologies was extended to women, who helped to spread the innovation.

Agricultural Development Programmes

The research Institute and the states' agricultural development programmes in the agro-ecological zone are known to carry out research and extension activities. The Institute was responsible for developing improved agricultural technologies, while the various states Agricultural Development Programmes (ADPs) carried out grassroots extension delivery of the technologies.[21] The farming systems' research programmes of the Institute and the states' agricultural Development programmes carried out the functions of transferring proven technologies through the following methods:

- monthly technologies review meeting;
- fortnightly training;
- zonal on the farm adaptive research; and
- small plot adoption technique.[22]

Monthly Technology Review Meeting

This is the primary forum for the transfer of improved technologies from the Institute. The Institute normally liaised with the subject matter specialist of the ADPs through theoretical training and practically improved technologies.[23] At this forum, the extension staff, through the research extension farmer-input linkage strategies (REFILS), update the scientists about the farmers input demand situation. In turn, the research scientists upgrade the technical staff and the input and the marketing agencies providing them with information on the supply situation for responding to farmer's reaction to any intervention by extension staff during the last month meeting. This review meeting is of utmost importance because subject matter specialists are trained on the Institute's improved agricultural practices, it also ensures that farmers are able to

capture the progress of technologies being promoted in their fields. The table below presents the workings of the monthly transfer review meetings of the Institute between 2001 and 2014.

Table 7

Conduct of Monthly Review Meetings in the South East Ecological Zone between 2001 and 2014

States	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Abia	10	10	10	11	11	9	7	4	3	3	4	6	7	9	104
Akwa Ibom	11	7	4	11	10	9	8	5	5	4	10	5	2	1	92
Anambara	10	1	6	4	3	3	4	6	8	2	2	5	8	1	63
Bayelsa	3	1	1	0	3	1	4	4	1	0	8	8	4	2	40
Cross River	4	0	0	0	1	3	1	0	0	0	3	0	8	3	23
Ebonyi	7	3	4	4	1	6	1	0	0	0	3	5	6	9	49
Enugu	10	8	6	8	4	8	6	7	10	4	7	2	9	3	92
Imo	9	8	0	9	10	8	7	8	9	9	10	7	4	7	105
Rivers	8	0	1	9	6	0	10	8	7	3	10	0	7	2	71
Total	72	47	41	56	50	47	48	42	43	26	57	38	55	37	659

Source: Compiled by the researcher from the South East Zonal Monthly Research Extension Farmer In-put Linkage System Workshop Proceedings 2001-2010.

The period under review neither enjoyed the World Bank support nor substantial financial assistance from the government. This perhaps was responsible for the observed irregular and reduced attendance to review meetings or non-attendance of some states in some years.

Fortnightly Trainings

These trainings are the key components of continuously up-grading and up-dating of professional skills of the extension agents held for a full day fortnightly. This is a forum for the training of extension agents by subject-matter specialists on improved agricultural technologies so that farmers would equally train the farmers.[24] Activities in this forum include, discussing specific practices that would be taught farmers during the coming few weeks, reports on the farmers input and marketing agencies, report of field problems that needed urgent attention and discussing personal field experiences. Each state's ADP's was made to organise the training fortnightly resulting in a total of twenty six sessions.[25] At the end of each training, the extension agents brought back field problems to the subjectmatter specialists. The table below shows the performance of the various state ADPs' in the agro-ecological zone and their activities between 2001 and 2014.

Table 8

Conduct of Fortnightly Trainings (FNT) in the Southeast Ecological Zone between 2001 and 2010

States	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Abia	24	26	26	24	26	23	30	24	22	21	24	16	27	29	342
Akwa ibom	22	23	23	23	22	22	22	24	24	26	10	5	2	1	249
Anambara	25	26	24	24	23	26	26	26	24	24	2	5	8	1	264
Bayelsa	24	23	25	22	26	7	-	-	-	-	8	8	4	2	127
Cross River	24	18	-	-	-	-	11	-	11	11	3	0	8	3	89
Ebonyi	24	20	25	23	25	21	22	24	24	24	3	5	6	9	255
Enugu	26	24	23	22	24	23	23	24	23	24	7	2	9	3	257
Imo	21	17	22	18	25	23	23	23	23	23	10	7	4	7	246
Rivers	23	24	24	24	24	24	20	23	24	24	10	0	7	2	253

Source: Compiled by the researcher from South East Fortnightly Research Extension Farmer-input Linkage System Workshop Proceedings, 2001 -2014.

From the table above, it can be observed that this training attained a degree of success. However, states of Bayelsa and Cross River performed abysmally low, which could be blamed on poor funding of the ADP's.

Zonal on the farm adaptive research

On station and on-farm research farming problems requiring on station experiments are refered to the institute by the state ADPs, for available solutions on farm applied research or on-farm adaptive research which is farmer managed.

Small plot adoption technique

This technique involves collaboration between the extension staff and the contact farmers using farmers farms or farmers meeting places. The extension staff encourages the farmer groups to individually try the technologies in a small plot of 5mx5m or 10mx10m as the case may be. In this process, the farmer can compare the small plot with an equivalent plot of his usual practice.

Adopted Village Scheme

The Institute introduced this scheme in 2010; it initially involved the identification of two villages not more than twenty kilometres from the Institute, aimed at introducing the best farming practices. The communities identified were Ubaha oriendu and Amawom.[26]Ubaha - oriendu is located in Umuahia North Local Government Area, while Amawom is in Ikwuano Local Government Area.[27] Each community provided demonstration farms for the project.

Objectives of establishing the Adopted Village Scheme include to:introduce them to the best farming practices;introduce value addition to root and crops;introduce them to improved root and crop varieties; and introduce them to the use of mechanized agriculture.[28]

Two research scientists, superintendents and ad-hoc staff were provided by the Institute, one for each community. Mr. C. Onuoha was for Ubaha -oriendu community while Mr. N. C. Ezebuiro was for Amawom community.[29] Farmers were taught modern farming techniques through the use

of participatory approach (involving teaching and demonstrating of the techniques on the demonstration plot). Thereafter, improved root and tuber varieties were distributed for the participants' personal farms.[30] The Institute's scientists for the communities undertook periodic evaluation of the crops planted on the participating farmers farms.

It is on record that the demonstration farms recorded impressive yields. For instance, Amawom was said to have recorded 3850kilogrammes of cassava, while Ubaha- Oriendu recorded 4500kilogrammes of cassava, in a plot of land as against yields from their local varieties planted on the adjacent farms. Also Amawom recorded 1342 kilogrammes while Ubaha-oriendu recorded 1858 kilogrammes.[31] The adopted village farms also served as multiplication centres for the institutes' improved varieties.[32]

In 2013, the second phase of the scheme was conducted at Mbato in Okigwe Local Government Area of Imo State, while Umumbo in Ayamelum Local Government Area of Anambra State and Akoli-menyi in Bende Local Government Area of Abia State also featured about the same time.[33] The activities at Mbato village included the selection of the site for cassava multiplication, teaching of modern farming techniques, planting of the improved varieties in a three hectare land and the distribution of cassava cuttings to women groups. Varieties planted included TME 419, TMS 98/0505, among others.[34]

Plate 9: NRCRI adopted village scheme

Source: *C.N Onuoha survey,2013*

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At Umumbo in Ayamelum Local Government Area Anambra State activities included the acquisition of four hectares demonstration farm. Varieties planted included TME 419, TMS 98/058, NR 8082, among others.[35]At Akoli-imenyi community activities included four hectare demonstration plots; planting cassava varieties of TME 419, NR8082, TMS 98/0581, TMS 98/0505, sweet potato while varieties of NRSP/05/022 and yam minisett technologies featured. Technologies demonstrated and extended to farmers included seed multiplication techniques, orange-fleshed sweet potato and pro-vitamin-A cassava varieties. Farmers were also taught processes of cocoyam and yam from the minisett technologies, correct fertilizer application, and land preparation methods.

Table 9

Activities/Technologies Disseminated at the Adopted Villages by the Institute

Villages	**Improved cassava varieties**	**Sweet potatoes varieties**	**Cocoyam varieties**	**Yam varieties**	**No of particip-ating farmers that registered**
Oriendu village	Introduction of Pro-vitamine A cassava variety. Multiplication techniques and cassava value added products production and marketing techniques.	Introduction of orange fleshed potato, improved planting techniques and large scale farming.	Cocondia improved farming technniqes.	Yam minisett/ Maize intercrop.	91

Igbariam village	Introduction of Pro-vitamin A Varieties, farming techniques. Side by side planting of Improved specie and the popular local varieties.	Introduction of Orange fleshed sweet potato varieties.	Proper farming techniques of Ede Ofe cultivation.	Introduction of dry season ans wet season yam production.	117
Umualumaku /Umulum Village	Planting techniques and recommended spacing for cassava. Introduction of improved varieties and weeding processes.	Planting techniques and recommended spacing for orange fleshed sweet potato varieties.	Ghana Coco and Ede ocha cultivation, harvesting and storage.	Introduction of yam minisett technology. Intercropping and weeding.	72
Obafemi Awolowo University Ile-Ife, Osun State	Introduction of yellow root cassava varieties. Proper harvesting and storage.	Introduction of orange fleshed sweet potato. Harvesting and storage.	Coco ndia cultivation and storage.	Inter cropping and storage processes.	109
Amawom	Introduction of yellow cassava root and other improved varieties. Proper planting and	Introduction of Ex-Igbariam and orange fleshed potato	Introductio n of Ghana coco, coco India, ede	Yam intercropping and minisette production.	200

	spacing techniques. Cassava intercropping, weeding processes, correct fertilizer application, introduction of value added products like cassava flour and product production like cakes, bread. Fertilizer technique application.	production.	ocha and Ede ofe.		

Source: Compiled from fieldwork, on Adopted Village Scheme 2010 - 2014.

Adopted School Out-reach Scheme

The Institute introduced this scheme in 2010[37] It was originally established in school farms of two choice schools, located within 20 kilometres distance from the Institute. It was aimed at serving as laboratories for showcasing agricultural technologies developed by the Institute, in addition to being an Agricultural Outreach Centre (AROC), jointly managed by the school and the Institute.[38]

Objectives of setting up these schools include to: make it a resource center with up-to-date information and various aspects of agriculture; provide agricultural bulletins, guides, compact disc (CDS), videos, textbooks and other materials; promote modern agriculture and value

addition in school farms; organise excursion, practical training and demonstration for the students; and formation of the students into young farmers club.[39]

The institute's first Adopted Schools were Ibeku High School in Umuahia North Local Government Area and Santa- clux School in Umuahia South Local Government Area of Abia State.[40] The projects were manned by two research scientists from the Institute, Mr. C.Onuoha and Mr N.E Ezebuiro. After the demonstration scheme had been acquired (school farm), planting of improved varieties was commenced on the farm, the improved varieties had features like high yielding, early maturing and drought-tolerant. Farming techniques extended were weed frequency and recommended fertilizer application among others.[41]

The programme in 2012, was extended to Wesley Seminary,Ndoro in Ikwuano Local Government Area of Abia State. The students received training on improved farming techniques from the research scientists, in addition of planting improved cassava varieties of TME 419, NE 8082, 98/0505 and sweet potato variety of NRSP/05/022.[42]

Over time, other schools were incorporated into the programme. In 2013, St. Augustine Grammer School, Nkwerre, Nkwerre Local Government Area of Imo State, St. John Science and Technical School, Alo and Caray College International in Umuahia South Local Government Area, became the institute's adopted schools but under community co- sponsor project.[43] This situation was a result of the Institute's inability to solely finance the project. Techniques extended to the students included field maintenance, application of herbicides and correct method of fertilizer application, among others.

The Institute from time to time is known to adopt more schools which are regarded as target schools. Such Schools are used to carry out demonstrations of the Institute's new products. Records have it that with the introduction of the orange-fleshed sweet potato, the Ahaieke

Community Primary School and Michael Okpara Staff School were made orange-fleshed sweet potato target schools.[44]

Various ways of adding value to orange- fleshed sweet potato were demonstrated to the students, to get products like buns, meat-pie, chin-chin, cake and many others.[45]These school farms serve as out -reach for the extension of the Institute's innovations in addition to seed multiplication centre for teachers and farmers.

The table below shows some of the adopted schools of the Institute and the innovations extended.

Table 10

Adopted Outreach Schools and Techniques extended by The National Root Crops Research Institute Umudike

Schools	**Techniques**	**Sweet Potato Technique**	**Cocoyam Technique**	**No of Students**
Christ Academy Secondary School Amuro, Imo State	Cassava Stem Multiplication Technique.	Sweet Potato Production.	Ede ofe cultivation, multiplicat-ion technique	100
Bishop Nwedo Memorial Boys High School Ossah Umuahia North Local	Cassava cultivation and spacing techniques.	Orange fleshed potato cultivation and	Coco Ndia cultivation	91

Government Area, Abia State.		harvesting.		
Santa-crux Olokoro, Umuahia South Local Government Area, Abia State.	Cassava cultivation, ferlization and harvesting.	Sweet potato farming techniques.	Cocoyam minisett technology production.	45 boys, 6 teachers
Ibeku High School Umuahia North Local Government Area, Abia State.	Cassava cultivation and inter cropping, weeding and fertilizing.	Orange fleched sweet potato cultivation and storing.	Cocoyam chip production and flour.	120
Community School Igbariam, Anambra State	Cassava cultivation, storage and value added processes, cassava flour cakes, bread among others.	Orange fleshed potato cultivation.	Identification of diseases and solutions	71
Model Secondary School, Umualumaku/Umuhim, Ehime Mbano Local Government Area, Imo State.	Improved cassava varities cultivation, Multiplication, method of planting cassava using 2 and 3 nodes	Introduction of Orange fleshed sweet potato.	Diseases identification in cocoyam.	79
Akpa Community	Improved cassava	Identification of	Rapid	130

Secondary School Allan, Benue State.	varieties cultivation, rapid multiplication processes.	diseases in sweet potato.	multiplicati on of Enugu local best specie.	

Source: Compiled from Fieldwork on NRCRI Umudike's Adopted Schools, 2010 - 2014.

The above table indicates that there was dissemination of the Institute's innovations and improved varieties, using the Adopted School Out-reach Programme.

Plate 10: NRCRI Adopted School Programme

Source: *O.C Aniedu survey,2010*

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CHAPTER FIVE

OPERATIONAL ACTIVITIES AND ACHIEVEMENTS OF THE INSTITUTE

The activities of research institutes follow a long, rigorous process of trial and re-trial of research. Research could take as many as five to ten years as the case may be to achieve results. The National Root Crops Research Institute was structured into divisions and further sub-divided into programmes and units to achieve results. These include the following:

Root Crops Research Division: sub –divided into the following programmes- cassava, sweet potato and minor root crops, and units of turmeric, ginger and rizga;

Tuber Crops Research Division: sub- divided into the following programmes -yam, potato, ginger and cocoyam;

Biotechnology and Product Development Research Division: sub –divided into the following programmes- biotechnology, product development research and seed technology;

Farming System Research and Extension Division- sub- divided into the following programmes- farming system and extension; and

Planning, Monitoring and Evaluation Division.[1]

Root Crops Research Division

The division was made up of three programmes, namely: cassava, sweet potato and minor root crops.

Cassava Research Programme

The research thrust of this programme was designed to develop cassava varieties with yield potentials, high dry matter and starch contents of at least 30 per cent. It was aimed to increase production for local and international consumption.[2] Originally, the cassava products were

concentrated on crop yielding, dry matter and disease resistant which were farmer-preferred varieties.

From the years 1999 to 2008, the programme generated more technologies, including improved varieties of NR 87184 (NICASS 23), with features like general acceptance, resistant to cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bug, suitable for food, industrial use and lifestock.[3] In 2008, the programme developed NR 93\0199 (NICASS 28) with qualities like resistance to cassava mosaic disease, cassava green mite, easily compatible with indigenous culture, suitable for garri, fufu and flour for industries.[4]

Other products of the Institute, during the period under study, carried out in partnership with the International Institute for Tropical Agriculture (IITA) include the following:

- improved variety TME 419 (NICASS 18): its features included suitable for mixed cropping, resistant to cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bugs. It is suitable for food, industrial and lifestock feed production.[5]
- improved variety TMS 97\2205 (NICASS 19): its features include suitable for wide adaptation, high root yield (31.8t\ha), food production, industrial and lifestock feed production but not suitable for mixed cropping. It is resistant to cassava mosaic disease, cassava green mite and cassava mealy bug.[6]
- improved variety TMS 92\0326 (NICASS 20): with high root yields (45.5t\ha) resistant to cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bug but suitable for food, industry and lifestock feed.[7]

- improved variety TMS 98\0510 (NICASS 21): with features like, high root yields (37.5t\ha), resistant to cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bug. It is suitable for food production, industrial and lifestock feed production.[8]
- improved variety TMS 98\0581 (NICASS 22): their features include high adaptation, high root yields (39.5t\ha), resistant to cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bug, but suitable for food production, industry and lifestock feed production.[9]
- improved cassava variety TMS 92\0057 (NICASS 24): These are suitable for mixed cropping. They are resistant to cassava green mite disease, cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bugs, but suitable for food production, industrial and lifestock feed production.[10]
- improved variety TMS 96\1632 (NICASS 26): with high root yields (43.2t\ha), suitable for mixed cropping, resistant to cassava green mite, cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, but suitable for food production, industry and lifestock feed production.[11]
- improved variety TMS 98\0002 (NICASS 27) :with high root yields (48.4t\ha), could be harvested within ten months without a significant loss in yields of dry matter starch and garri. Resistant to cassava bacterial blight, cassava anthracnose disease, cassava green mite and cassava mealy bugs, suitable for food and lifestock feed production.[12]
- improved variety TMS 96\1089A (NICASS 29): with high root yields (49.7t\ha), containing moderate level of beta-caroten, suitable for the production of yellow garri without addition of palm oil.[13]

Plate 11: Cassava Programme of the NRCRI

Source: *C.O Chukwuleta field survey, 2017*

Plate 12: Some improved cassava varieties of the NRCRI

Source: *A.O Ano survey,2012*

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In addition to these activities, the programme developed higher micro-nutrient content cassava varieties, the higher B-caroten and other carotenoids fortified with vitamin A, which could enhance nutritional value of cassava through the production of yellow fleshed root.[14] It developed capacity for evaluating dual/multiple gene expression in cassava and transformation efficient for particle DNA transfer, and also developed cassava varieties suitable for ethanol production (TMS/8/0505) with dry matter, low fibre and high *amylore* qualities.[15]

From the early part of 2000-2014, the programme developed more improved cassava genotypes at Umudike, Igbariam and Otobi, as could be seen on the table below. In addition, three of these developed varieties were drought cassava genotypes CR 143 – 218, CN 450 – 106 and KN00[16]

Table I1

Cassava Varieties Released by the Programme and their Characteristics, 2001-2014

UMUCASS 36 (TMS 01/1368)	**UMUCASS 37 (TMS 01/1412)**	**UMUCASS 38 (TMS 01/1371)**	**UMUCASS 39 (NR 03/0211)**	**UMUCASS 40 (NR 03/0155)**
High Better Carotene (pro-Vitamin A)	High Better Carotene (pro-Vitamin A)	High Better Carotene (pro-Vitamin A)	Early Maturing	Early Maturing
Very Suitable for Garri and Fufu	Very High Yielding	Very Suitable for Garri and Fufu	High Yielding	High Yielding
Very Suitable for High Quality Cassava Flour	Very Suitable for Garri and Fufu	Very Suitable for High Quality Cassava Flour	Suitable High Quality Cassava Flour	Very Suitable for Garri and Fufu

	Broadly Adapted to different Environments		High Starch Yield	Tolerance to Drought

"Cassava Released Varieties 2009-2014,"

Source: Cassava Research Programme, NRCRI, 2014. p. 16.

The table above shows current cassava varieties from the programme developed between 2010 and 2014. They were five with diverse features like better carotene, early maturity, high yielding, easy adaptation, high starch yield, tolerance to drought and suitable for garri, cassava flour and fufu.

Sweet Potato Programme

The objectives of the programme include the following:

- breeding and selection of superior high yielding orange fleshed sweet potato (OFSP) and the variables adaptable to various agro-ecologies of the country;
- varieties with high root maturity, early maturity and high root dry matter content;
- breeding good germination and drought tolerance varieties;
- breeding varieties with shade tolerance, high protein, vitamin A and minerals such as iron;
- breeding sweet potato virus resistance disease;
- varieties with high starch content, good roots shape, storability, taste of the storage roots;
- varieties for industrial use with high sugar content for bio-fuel and pharmaceutical companies making drugs and glucose; and
- varieties with dual purpose-the leaves for consumption as vegetable for humans and folder for man.[18] Technologies produced by this programme in its early years included the use of four node-cutting as the basis of planting materials (2004) with special attributes like

Plate 13: Sweet potato Demonstration farm at the NRCRI and proceeds

Source: *T.N.C Echendu survey, 2015*

reduction in waste of planting materials required for field establishment, conformity to the needs of farmers and end- users, demand-driven technology, made good use of fertilizer 45:15:70 (NPK) for the north and 50:70:30 (NPK) for the south, with advantages like conformity with the norms of the farmers, and suitable for soil conservation.[19] The programme further developed TIS\0087 (*tropical ipomea series*) in 2007 with the attributes like high yielding of 20\30 tons\ha with pink and white flesh that was not easily attacked by sweet potato weevils.[20]

So many products of the popular potato varieties in Nigeria included the selections carried out and commercialised by the Institute, with its most recent products fortified by vitamin A, beta-carotene among others. They are shown on the table below with their diverse characteristics

Table 12

Potato varieties released and their characteristics, 2000 – 2014

Potato Variety	**Skin Colour**	**Blight Resistance**	**Crop Maturity**	**Tuber Dry Matter (%)**	**Tuber Yield t/ha**	**Common Use Form**
Nicola	Cream	Tolerant	Medium	18.6	26.6	Fries
Rc 767-2	Cream	Tolerant	Medium	19.4	24.8	Fries
Rc 3816-3	Light Red	Resistant	Medium	18.4	20.1	Fries
Rc777-3	Red	Resistant	Medium	20.1	26.1	Fries
Wc 732-1	Cream	Susceptible	Late	19.7	25.8	Fries
Wc 731-2	Cream	Tolerant	Medium	19.8	24.8	Fries
Br 63-18	Cream	Tolerant	Medium	21.5	25.1	Chips
Tls 25-32	Yellow	Resistant	High	31.8	42.6	Flour

Tis/ 8164	Cream	Resistant	High	30.4	40.2	Fries
Tis/087/0087	Orange	Resistant	High	32.1	45.7	Fries

"Varieties of Sweet Potato Released 2010-2014",

Source: Sweet Potato programme NRCRI, 2014. pp.14-15.

Within the period of study, the programme engaged in the trial and re-trial of varieties. The table above indicates that ten sweet potato varieties were released by the programme, with diverse characteristics and uses.

The programme was said to have developed improved storage facility innovation as an answer to the problem of the storage losses called the "diffusion light store," with the capacity of prolonging storage of seed potato for four – five months and a reduction of about forty– twenty per cent loss. The storage structures were constructed with eighty per cent local materials and had increased prospects for potato production for the country at large and consequently encouraged growth of potato twice a year.[21]

Also, it developed potato planting techniques and crop inter-cropping for high yields. Two of the released varieties (TIS 587\0087, TIS 8164) had higher yield potentials and tolerance for pests and diseases, with high yields and yield potentials of 30 – 40 t/ha, and 35 – 45 t/ha respectively. Both had nutritious vines and leaves, cherished by livestock (rabbits, sheep, goat and swine), and also were good for feeding fish in the ponds. TLS 2532 varieties were best for making high quality composition bread at the ratio of 50.50 wheat/sweet potato flour.[22]

Plate 14: Minor Roots Programme at thr NRCRI

Source: *C.O Chukwuleta survey, 2017*

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Minor Root Crops Programme

This programme was responsible for the improvement of other minor root crops long neglected such as turmeric, rizga, ginger and many others. Agronomic studies of the crops were mainly confined to Jos in plateau State. The institutional effort made by the Institute through the re-introduction and re-popularisation of these crops are known to have increasingly created awareness of the crops. For instance, in respect of the turmeric research unit, it is known to have carried out multi- location evaluation trials as one of the conditions for registration of varieties such as NCL 41, NCL 58, NCL14, NCL52, NCL04, NCL 25, NCL60 and NCL 36 yielding genotypes on 4 locations – Kuru, Otobi, Umudike and Igbariam, representing different agro-ecologies.[23] Meanwhile, the unit has developed a lot of agronomic products and packages which help in the increased outputs of turmeric, including mulching with straw 10cm, depth planting to optimize yield, planting from the onset of rains, fertilization at two weeks after planting, application of 2t\ha time among others.[24]

Ginger Research Programme

There was a new emphasis on the ginger production such as a cash crop. Based on this, a new out- station was established at Maro in the southern area of Kaduna State for ginger research and multiplication.[25] The programme has since effectively piloted the research programme with the following mandate:

- development of high yielding and disease resistant ginger varieties;
- removal of drudgery in ginger production industry through mechanization process; and
- development affordable means of storing and processing its quality.[26]

Arising from the above, considerable success was believed to have been made in ginger research as two varieties of ginger was made indigenous in Nigeria, UG 1 (Yellow Ginger) and

UG 2 (Black Ginger). Other cultivars *(Maran, Himachtimumal Pradesh, Rcode Janeiro, Wynad Local and Saint Vincent)* were introduced from India and were still at different trial level awaiting adoption.[27]

Apart from the above, other achievements of the programme included the development optimum rhizome minisett size for ginger seed multiplication, optimum planting depth for enhanced productivity; identification of compatible inter crop, especially inter-cropping ginger with soyabeans and okra aimed at better land use.[28]

It also developed application of agrolyzer micro-nutrient in combination with Nitrogen phosphorus and potassium (NPK) fertilizer for better ginger yields performance; developed alternative organic manure for ginger production with rice mill waste as effective mulching material.[29]

An outstanding area of achievement of this programme was in the development of ginger production technology for different agro-ecological zones in Nigeria. For instance, ginger splitting machine was developed in 1998 with the advantages of splitting about 5,000 kilogrammes of ginger rhizome/hour and reduce drudgery, very tolerant in wet conditions; splitting ginger for drying pre-production of optimum rhizome sett sizes (10 – 20grammes) for seed and ware ginger production and identification of leaf spot severity as a factor militating against the rhizome yields, and development for fungicide treatment (z force fungicide) for its control, and had extended the technique to farmers.[30]

Plate 15: Improved Ginger varieties and Ginger Demonstration farm at the NRCRI

Source: *A.Ironkwe survey, 2017*

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Tuber Crops Research Division

The tuber crops research was made up of four research programmes: yam, cocoyam and potato programmes. Each research programme was headed by a programme coordinator.[31]

Yam Research Programme

Yam research programme had the national mandate for:-

- the genetic improvement;
- self reliance in production;
- high processing development; and
- development maximum storage capacity.[32]

The programme has since its establishment, developed some products on their own as well as in collaboration with the International Institute for Tropical Agriculture (IITA). The technologies generated since 2001 include TDR 89\02565, TDR89\02461 and TDR 89\02677.[33] These yam varieties are hybrid with special features like high yielding, pest and disease tolerant, best for pounded yam, frying and boiling, with potential yields of 27-30t\ha. In 2003, it developed other hybrid varieties of TDR89\02665, TDR89\01213, TDR95\01924 and TDR89, with yielding potentials of 27-30t\ha, higher than current farmers yields of 10-15tha.[34]

In addition, since 2008, it has developed dry season yam varieties of TDR 95\00925 and TDR 03\00193, suitable for swampy areas. Its features include shorter dormancy period, early maturing, very tolerant in wet condition, pest and disease resistant, ,high adaptive rate with more favourable yields of 15-20t\ha as against 10-15t\ha recorded during normal season. It also developed hybrid yams TDR\98\01166, TDR 98\01168, TDR98\01176, that is wet condition tolerant with potential yields ranging from 23-26t\ha which has facilitated off season availabilility of yams.

Plate 16: Improved Yam varieties of the NRCRI

Source: *O.N Eke-okoro survey, 2017*

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Plate 17: Yam Demonstration farm at the NRCRI

Source: *C.O Chukwuleta field survey, 2017*

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It conducts periodic trainings on methods of identification and selection of healthy seed yams, proper cutting of yam minisett, seed dressing, treatment with recommended chemicals, planting and spacing methods, optimum plant population, starking, weeding, application of herbicides and fertilizer to yam farmers within the yam producing areas of the North-central zone of Zakibiam, Makurdi, Katsina-ala among others.[36]In addition, between 2009 and 2014, it developed more hybrid yam genotype Amo 999/064, Amo 999/109, Amo 999/060 and Amo 999/144.[37]

Cocoyam Research Programme

The mandate of this programme include but not limited to the following:

- genetic improvement of cocoyam;
- development of cocoyam adaptation trials;
- development of organic and inorganic fertilizer requirement of cocoyam;
- cocoyam multiplication; and
- control of cocoyam leaf blight.[38]

Before 1990, cocoyam production was beset with lots of challenges which included scarcity of quality planting materials, low genetic base of improved varieties, lack of effective storage facilities, poor shelf of corns and cornels, declining soil fertility and incidences of diseases.[39] However, the cocoyam research programme has developed about five elite cocoyam cultivars under upland ecologies, built good quality planting materials and distributed them to farmers in the zone and state ADPs.[40] It also introduced (*pecie of tara colocasia esculeta*) which was a cherished cocoyam used in soup thickening, and it is said to have the potential for

preventing breast cancer. It has also developed rapid multiplication technology, also known as "Gocken" multiplication technology, for rapid multiplication.[41]

Cultivars produced by the programme

1. *Xanthosoma spp*

- NXS 001 (Ede ocha)
- NXS 002 (Ede uhie)
- NXS 003 (Okorokoro)

2. *Colocasia spp*

- NCE 001 (Coco India)
- NCE 002 (Ede ofe, green)
- NCE 003 (Ede ofe, purple)
- NCE 004 (Ede ofe, giant)
- NCE 005 (Ukpong)
- NCE 006 (Ghana)

The programme is also known to have made crosses amongst the exotic genotypes and the local varieties, and recorded successful hybridization of *colocasia* for conventional breeding.[42] It helped many farmers to adopt inter-croppings especially between cocoyam and ginger.

Plate 18: Cocoyam Demonstration farm at the NRCRI and proceeds

Source: *G.O Chukwu survey,2017*

It has further identified cocoyam pre-harvest challenges and introduced effective dissemination of numerous agricultural technologies for increased yields to farmers[44]. Studies were known to have been carried out among major cocoyam farmers and extension agents in the agro- ecological zone. Findings as a result led to a significant breakthrough in cocoyam technological development which led to improvement in the production of cocoyam.[43]

Biotechnology Programme

This programme was charged with the responsibility of using living organisms or substances, derived from them to make or modify a product, improve plant or animals or develop micro-organisms for specific uses. It made use of modern tools in plant biotechnology which included techniques in plant tissue culture, molecular makers, diagonostic and genetic engineering technology.[44]The use of these tools in crop improvement impacted positively on agricultural productivity, nutritional quality and environmental protection, and led to enhanced food security.[45]

Biotechnology provides means of designing crops for specific environments which was a major departure from traditional agriculture and applied it for improvement of crops, enhancement of nutrient, pest and disease control, production of herbicide resistance in crop and tolerance to a variety of environmental stresses.[46]

Also biotechnology allowed for the transfer of only one or a few desirable genes, and by so doing, permitted scientists to develop crops with specific beneficial traits and reduce undesirable traits.[47] The activities of the biotechnologists at the Institute were therefore delivered in three folds: plant tissue culture, genetic engineering strategies and bio-fortification.

Plant Tissue Culture

This was the first aspect of biotechnology at the Institute.[48] It was the major technology for the production of disease free and high quality planting materials.[49] It included micro propagation, embrayo rescue, plant regeneration from cell suspension and protoplast anther and microspore. They are particularly used for large-scale plant multiplication; it utilised potent ability of plant cells to generate complete plants.[50] Clusters of plant cells were cultured into nutrient – rich media to produce clones of the plant from which the cells were removed.[51] This allow for rapid production of large numbers of plants with advantageous characteristics.

Genetic Engineering Strategies

This could be regarded as the DNA technology,[52] for the collection of experimental techniques that enabled scientists to identify, isolate and propagate fragments of the genetic material *de-oxyribonucleric acid* (DNA) in pure form.[53]

Biofortification

Biofortication is known as biotechnology at the National Root Crops Research Institute Umudike. It is a relatively new field in the research institute, established as a result of loss of crops in germplasm bank of natural survey in 1982.[54]In addition to the Institute's germplasm loss as a result of exposure to biotic and abiotic stress factors,[55] these two events set in motion for in-vitro gene bank. In contrast, the in-vitro gene banks were reliable and served as complementary back-up to field set-up, as it collected large collections conveniently in a small space under aseptic and controlled environment.[56]

Left with nothing to work with, the need arose for the acquisition of new and exotic crops from international sources. This necessitated the conversion of an already existing laboratory

(plant/insectory) to a biofortification facility since the resources to put up an appropriate structure was lacking.[57]

The programme was equipped to handle micro propagation of accelerated multiplication propagules of parent cultivator, virus cleaning through *meristem-tip* culture for the production of clean and healthy planting materials.[58] Low-cost protocol was also developed for the culture of various root and tuber crop, thereby making it a training ground for students on industrial attachment, undergraduate and graduates undertaking their projects for M.Sc and Ph.D degrees.[59]

In 1990, a state of the art Bio-fortification laboratory was built, it was said to have been funded by the International Atomic Energy Agency (IAEA) through a technical project.[60] In 2005, a molecular biology laboratory was set up, in collaboration with Center for Potato Research (CIAT) Columbia.[61] This development ushered in the use of molecular tools in the breeding of root and tuber crops with cassava blazing the trail,[62] and introduced marker assisted selection aimed at reducing tedium of the breeding process.[63] Being the only functional molecular biology laboratory in the south-east, it aided training for students in universities and other institutions of higher learning beyond the South-east.[64]

Plate 19: Biotechnology Programme at the NRCRI

Source: *C.O Chukwuleta field survey, 2017*

Plate 20: Biotechnology Laboratory at the NRCRI

Source: *C.O Chukwuleta field survey, 2017*

Since its inception, the programme has engaged in not less than eight (8) major biotechnology-related projects, which was made possible by collaborative project with advanced laboratories and donor agencies, as could be seen in the table below.

Table 13

Biotechnology-related Projects Carried out at the National Root Crops Research Institute, 2005 – 2014

S/N	TITLE	SPONSOR
1.	Mutagenesis in breeding, root and tuber crops	International Atomic Energy Agency (IAEA)
2.	Improvement of root and tuber crops through induced mutation breeding and in-vitro culture technology.	International Atomic Energy Agency (IAEA)
3.	Mutation and molecular breeding in cassava.	International Atomic Energy Agency (IAEA)
4.	Adding value to root and tuber crops through mutation induction and biotechnologies.	International Atomic Energy Agency (IAEA)
5.	Ginger micro-propagation and seed storage.	Food and Agricultural Organisation (FAO)
6.	Nigeria agricultural biotechnology programme.	United States Agricultural Aid (USAID) ,Bill and Melinda - Gates Foundation
7.	Cocoyam mciro-propagation and seed storage	World Bank
8.	Bio-Cassava Technology Plus	Bill and Melinda Gates foundation

Source: Bio-technology programme, NRCRI Umudike, 2017.

This table shows some sponsored projects of the programme in the recent past and the collaborating donor agencies and international organisations.

According to available information, the projects could take the form of human capacity building, infrastructural, supply of major equipment and genuine chemicals. The aid from the donor agencies, kept the laboratories functional over the years, in addition to helping them to widen their scope of research.[65]The most recent collaborative project is the Bio-Cassava Technology Plus (BCT) project funded by the Bill and Melinda Gates foundation.[66] The project aimed at addressing the chronic micro-nutrient deficiency of cassava by the delivery of nutritious, vitamins and mineral enriched cassava for the teeming African poor population who depended on cassava as a major staple.[67]Under this project, the programme blazed the trail as the first to obtain approval to conduct confined field trials of genetically moderated cassava in Nigeria.[68] The project provided a level bio-safety screen house and constructed a confined filed trial site.[69] Four Research Scientists has so far been trained under its human capacity in Tissue Culture, Molecular and Transformation Techniques at the Donald Danforth Plant Science Center, Missouri in United States of America, in preparation to domesticating transgenic research at the institute.[70]

Other achievements of the programme are in the following areas:

- zinc bio-fortification of cassava storage roots;
- evaluation of red fluorescent protein, an alternative report gene for cassava transformation;
- improvement and deployment of markers for biotic stresses in cassava;
- development of mapping population towards marker assisted recurrent selection for drought tolerance and improved productivity in cassava;

- comparative studies of granular starch hydrolyzing enzyme and brewing starch hydrolyzing enzyme for ethanol production from cassava and cassava flour;
- qualitative trait *loci* mapping for *caroteniod* content in *Si families* of cassava;
- in- plant transformation strategies for elite cassava cultivars and
- molecular characterization of its mandate crop collections.[71]

Farming System Research and Extension Division

This division comprised three programmes, they included:

- Farming System Research Programme;
- Extension Service Programme; and
- Post Harvest -Technology Programme.[72]

Farming System Research Programme

Farming System Research and Development emphasized applied research by conducting most researches on farmers' fields to enable it monitor farmers to obtain research results. Technologies developed by the programme include embarking on periodic evaluation of adoption rate and impact of these technologies on the livelihood of the farmers.[73]

The activities of the Farming System Research Programme is directed towards solving production problems of farmers in the South-east and South-south agro-ecological zone. The objectives of the programme include, but not limited to:

- carry out diagnostic and thematic surveys with a view to identifying major constraints to farmers in the agro-ecological zone, comprising Abia, Akwa- Ibom, Anambra, Bayelsa, Cross river, Ebonyi, Enugu, Imo and Rivers States;

- conduct on-station research into the total farming system of South-East agro-ecological zone in order to develop technologies that are sustainable, technically feasible, economically viable and socially acceptable to the farmers in the zone;
- conduct on-farm adaptive research (research and farmer managed) in collaboration with the ADPs in South-east zone in order to evaluate promising technologies on farmers field; and
- transfer proven technologies from research to subject matter specialist for on-ward transmission to farmers.[74]

The programme's proven technologies are transferred through the monthly technology review meetings with the various state ADPs.[75] It adopts and transfers minisett technologies, follows farmers feedback on the adoption of minisett technology, and inter-croping farming. For instance, it is on record that the result of the programme survey indicates that eighty per cent of seed yam growers grew yam minisettt inter-cropped with maize in major yam farming areas of the zone[76]. Furthermore, a good number of improved cassava varieties released by the Institute were successfully transferred to farmers in the zone, which may have resulted in raising cassava production level to forty three million metric tones per annum as against twenty seven metric tones previously recorded.[77]

It adapts and transfers improved sweet potato varieties developed by the institute in collaboration with International Institute for Tropical Agriculture (IITA), Ibadan and International center for Potato (CIP) Peru, among which are TIS 87/0087 and TIS 8164. These has considerably replaced the local varieties in the zone.[78]

It develops and transfers cocoyam technologies and improved varieties to farmers which may have led to increasing cocoyam production by more than thirty per cent in the zone as well as in other parts of the country.[79]

The Institute also collaborates with sister Institutes in order to extend their complementary products to the farmers in the zone, notably, the National Animal Production Research Institute Zaria, in adoption and transfer of rabbit farming, aimed at teaching rabbit production to farmers in the zone. It is on record that about twenty per cent of major farmers in the zone engage in rabbit farming.[80] The National Institute for Fresh Water Fisheries Research New-Bussa also extended homestead fish farming to farmers in the zone between 1998 and 2014. This may have led to an increase of about fifteen per cent fish farming in the zone.[81] It is also on record that the National Cereals Research Institute Badeji, introduced upland rice varieties which may have probably led to an increase of about ten per cent rice production among farmers in the south-east and south-south zones.[82]

Plate 21: Farming System and Extension Services at the NRCRI

Source: *C.O Chukwuleta field survey, 2017*

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Extension Service Programme

The programme is charged with the responsibility of re-vitalizing the Institute's agricultural extension services machinery, through promotion, popularization and dissemination of relevant research findings. The objectives of the programme include, but not limited, to:

- produce radio/television broadcast programmes with major electronic media in the south-east as well as the national media houses for dissemination of the Institute's activities and technologies;
- promote and disseminate the Institute's new research findings through print media such as newspapers, magazines, pamphlets and the institutes news bulletin;
- develop, revises and updates posters, extension guides, leaflets on root and tuber crops technologies as well as other relevant resources to the farming system of the south-east agro-ecological zone;
- establish and use demonstration plots for proper production practices to showcase prototype on farm evidences of various technologies developed by the institute.
- teach through guided tours of the institute's farms, laboratories, engineering, unit life farms, laboratories, engineering and exhibition units;
- promote and projects the Institute's relevance in national development through active participation in National and State agricultural shows, field days, trade fairs and other public activities, and by so doing, provide platform for showcasing the Institute's technologies to potential end users;
- upgrade and strengthens knowledge and skills to farmers on improved agricultural production and post-harvest technologies through ad-hoc trainings; and

- establish demonstration plots to show case improved root and tuber crops technologies from the institute.[83]

The programme conducts visitors on guided tours of the institute's model farms and facilities. It maintains NRCRI agricultural columns in print media such as Imo News papers, Newswatch, Tell Magazine, Food Security Magazine among others.[84]

Below is a table showing the print media as an agent information dissemination of the Institute.

Table 14

Distribution of Activities of the National Root Crops Research on Print Media, 2000 – 2014

Media Programmes	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Radio	11	3	8	9	31	46	31	17	96	96	20	12	24	18	23
News paper articles	2	4	7	9	33	31	44	12	61	84	14	16	28	20	18
Magazine articles	6	7	9	5	23	31	37	9	25	30	15	9	8	16	10
Retrievable Resource materials	4	6	4	4	17	41	43	14	3	2	-	14	9	17	28
Total	23	20	28	27	104	149	155	43	175	212	49	41	69	71	79

Source: Compiled by the researcher from NRCRI Annual Reports, 2000 - 2014.

The above table is an indication that technologies dissemination was embarked upon by the programme.

The programme also featured on radio programmes such as farm broadcast, news items, transmitted through Imo broadcasting services (Imo Broadcasting Corporation), Broadcasting Corporation of Abia, Federal Radio Corporation of Nigeria (local and national), Vision Africa Radio, Akwa Ibom State Broadcasting, Enugu State Broadcasting Service and Ebonyi State Broadcasting Corporation, among others.[85]

The programme transmittes the institute's technologies through press releases, documentaries and live programmes in media organizations such as Broadcasting Corporation of Abia State, Nigerian Television Authority (NTA), African Independent Television (AIT) among others.[86]

It produces and packages retrievable electronic resources materials such as video clips and photo documentaries. It publishes several farmer and extension resources materials in the form of extension guides such as Guide to Cassava Production, Guide to Cassava Stem and Root Production, Guide to Rapid Multiplication of Seed Yam by Minisett Techniques among others; posters as well as the institute's agricultural information bulletins, (NRCRI News Bulletin), were at one time or another used to disseminate its activities.[87] The table below contained the distribution of extension resource materials within the period under review.

Table 15

Distribution of Farmer-Extension Resource Materials Published by Extension Service Programmes 1980 – 2014.

Publications	1980-1990	1990-1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Extension Guides	7	10	2	3	2	1	1	3	6	7	6	3	1	4	20	18	36	130
Rosters/leaflets	10	15	4	2	1	4	-	1	2	6	6	-	-	18	30	42	45	186
News Bulletin	18	16	3	2	1	2	3	2	2	2	2	1	-	5	16	18	20	113

Source: Compiled from Field Survey, 1980-2014.

From the above table, it can be deduced that the activities of the institute was dissemminated by the programme.

Apart from these activities identified, It also organises ad-hoc training for farmers and other users of the Institute's technologies, aimed at equiping them with prerequisite skills and knowledge, to stimulate their entrepreneurial interest necessary for eliciting investment in agriculture. Participants in these programmes acquire skills and knowledge in root and tuber crop production, processes and utilises the technologies for business, income generation and household livelihood.[88]

The table below may further explain to the reader the processes of training by this programme to the farmers.

Table 16

Distribution of Training Programmes, Demonstration Farms and Field Days Organized by the Extension Service Programmes from 1976 – 2014.

Ad-hoc Organizations	1976-1980	1981-1990	1991-2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
No of Participants	10	20	35	3	7	-	150	1498	2303	2206	1250	1267	435	40	50	55	60
Demonstration Farms	2	4	9	4	10	-	18	-	03	03	50	40	36	6	12	18	22
No. of technologies	4	3	10	8	10	9	25	27	30	37	37	45	50	51	40	60	89
Outreaches	-	-	-	-	2	-	-	-	-	-	-	3	4	6	10	13	14
Field/Exhibitions	-	-	-	-	-	-	2	6	5	3	2	6	34	40	46	50	136

Source: In the table above, the programme made use of four mediums in farmers training within the study time, the include demonstration farms, outreach, field trips and exhibition. It indicates that training programmes actually took place at the institute.

Post-harvest Programme

This programme conducts research into the following areas:

- process roots and tubers into value- added products;
- markets and stores roots and tubers and their processed products; and
- designs and fabricates equipments for processing roots and tubers.[89]

The Scientists at the programme processes roots and tubers into products such as confectionaries, non-alcoholic beverages/drinks, salad creams and other food forms including cocoyam-soybean-crayfish based complimentary weaning food, instant baby food from a mixture of cocoyam, soybean and crayfish flours, cocoyam soup thickners, composite flour for instant fufu preparation, breakfast food for edible frifoliate yam, ginger flavoured pineapple drink, among others.[90]

It researches into under-exploited roots and tubers such as cocoyam, water-yam and minor root crops and develops acceptable crisps (fried chips). For instance, cocoyam chips was first developed by the programme and has been marketed to farmers in many parts of south-east zone.[91]

It fabricates machines for roots and tuber processors like the all-purpose dryers, pulp/mash pulverizer/shifter, active solar drier for agricultural products, continuous centrifugal cassava prototype dewatering machines. All these are on display at the programme.[92]

Plate 22: Some value added products of the Post-harvest Programme at the NRCRI

Source: C.C *Aniedu survey,2016*

Plate 23: Post-harvest programme of the NRCRI and commerical driers

Source: *C.O Chukwuleta field survey, 2017*

It organises periodic training for farmers of the agro-ecological zone, on small-scale processing of high quality cassava flour.[93]It also embarks on quality evaluation of fresh and processed forms of roots and tubers, aimed at ascertaining chemical, biochemical, and microbiological safety of food production, aimed at increasing its consumer acceptance.[94]

It develops livestock feed trials root crops peels. It is on record that the programme developed feed using orange flesh sweet potato peels, cassava root meal supplement with palm and cocoyam peel meal, as a substitute for maize as a resource of dietary energy.[95]

The programme's activities have greatly increased root and tuber lifespan by processing and transforming them into value added products with enhanced shell life. For instance, Cassava and sweet potato has been processed into flour and chips. It further identified, orange fleshed sweet potato as an alternative to carrot in vegetable salad preparation. In line with the above, it organises periodic trainings for vegetable salad consumers, caterers, chefs and food farmers from the agro-zone.[96] It also produces orange- fleshed sweet potato based drinks for combating vitamin A deficiency, and organises training for its mass production by food drink industries. It also developed sweet potato garri, aimed at adding nutritional value to sweet potato. This was done by grating and fermenting potato for 1-2 days and then fried to produce sweet potato garri just like in cassava. The product has been extended to about ten per cent farmers in major potato producing communities of the zone.[97]

Other achievements of the programme include production of high quality starch for use in laundry and food preparation, production of ginger flavoured non – alcoholic drink, development of a pit storage– technique for preserving ginger rhizomes up to twelve (12) weeks after harvest, cassava chipping machine, hydraulic jack cassava presser with starch recovery device, and the ginger splitting machine, among others.[98]

Plate 24: NRCRI Irrigation system for dry season farming

Source: *O.C Aniedu survey,2017*

Farm Mechanisation Unit

It could be regarded as the service organ of the institute, providing farm based services and charged with the responsibility of maintaining the 240 hectares landmass at the institute. The objectives of this unit included but not limited to the following:

- timely field preparation for experimental and production purposes;
- proper field maintenance such as clearing of in-farm roads;
- erosion control, conservation of the resource base of the production system;
- planning and execution of preventive maintenance of farm machines; and
- implement use, manpower training and development of tractor machine operators.
- maintains the existing water dam and supply water for irrigation of crops, maintains farm implements of the institute as well as maintains demonstration plots.[99]

It prepares all the demonstration farms every farming season, and maintains the farms all year round. It is also in charge of on-ground research experiments, and gives situational report or feedback to the research scientists, thereby aiding research.

It maintains all the Institute's farm machines and implements, and is also responsible for the hiring and periodic service of all the equipments, in addition to supervises and operates the equipments on the farms of farmers that hired the equipments.

It organises periodic trainings for technicians and farmers on operating of the farm machines, and extends technical support to all the State ADPs farm implement operators.[100]

Planning, Monitoring and Evaluation Division

It was established as an integral part of the director's office, with the following responsibilities:

- advance budget and staff proposals;

- staff training;
- payment of fees and allowances; and
- monitoring of training programmes.[101]

Planning, Monitoring and Evaluation Division comprises of three units: Research Planning; Project Monitoring and Evaluation, and Manpower Development and Training.[102]

Research Planning

This unit is responsible for research planning and formulation, it organises annual research review workshop where the stakeholders meet to review the previous year's research, identifies production, storage processes, utilization, marketing and other problems affecting the institute.[103]

Projects Monitoring and Evaluation

It is incharge of monitoring and implementing research projects from planning to completion, aimed at ensuring proper implementation of the projects in accordance with planned objectives and financial budget.[104]

Manpower Development and Training

It determines staff constraint while conducting annual *skill-gap* analysis in all divisions of the Institute. The *skill-gap* analysis provides information on staff recruitment and training needs of the Institute, made up of post graduate course (M.Sc & PhD); short courses; industrial training for students, and National Youth Service Corps scheme.[105]

Other activities of the division include but not limited to**:**

- develop capital budget;
- monitor research projects and works at headquarters and outstations;
- organise annual research review and planning workshop;

- publish the Institute's Annual Report/ Programme;
- organise station seminar and publishes proceedings;
- produce the Institute's budget performance report;
- evaluate research projects;
- coordinate out-station activities;
- develop data bank for yields of crops produced;
- analyse research data for research officers and experimental designs; and
- post research officers, agricultural superintendents, laboratory technologist and agricultural field overseers.[106]

Plate 25: NRCRI Administration Building

Source: *C.O Chukwuleta field survey, 2017*

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CHAPTER SIX

CHALLENGES/ CONSTRAINTS OF THE NATIONAL ROOT CROP RESEARCH INSTITUTE UMUDIKE

Having examined the activities of the National Root Crops Research Institute Umudike, it is time to analyse what may be considered as its challenges. These challenges are examined under the following order:

Funding

It is no gainsaying that funding is the lifewire of every establishment. Finance, in fact, is the key element that serves as a tool for achieving, tidying and transporting research innovations from source to end users[1]. Agricultural research impact could be made more visible and expansive through adequate investments by supporting appropriate research capacity infrastructure.[2] However, it has been observed that over the years, funding has been a major constraint to the growth and development of the Institute. This has manifested in dual-folds of inadequacy and late release.

Inadequacy of funds has grossly affected upgrade of laboratory equipments; prompt delivery of agricultural information to the farmers through extension service; studying farmers agricultural imput and output progress; breeding work; raising of seedlings for farmers; irrigation facilities; generating sets for pumping of water, among others. The Institute has over the years witnessed "envelop funding" from the Federal Government, of which the greater percentage goes to payment of salaries and wages.[3] This situation has multiple effect of the Institute, among which are high level of redundancy among researchers; instead of conducting meaningful research and inability to initiate meaningful projects among others.

This inadeaquacy of funds also affect overhead allocations, which result in the decay of existing infrastructures. There are about 25 kilometres of the internal and farm road which has been seriously eroded and left unmotorable especially during the rains.[4] Most of the residential quarters are known to be leaking as a result of the hail-stone which damaged the roof of the buildings in 2002. And generally the quatres are in a state of dilapidation.[5]

The second-fold is in the area of late release of funds. Funds for the Institute are usually released towards the end of the year, between August and September.[6] This situation is inimical to both short-term spending and long time planning, as such, no country has sustained agricultural growth without consistent research and development.[7] As an agricultural research Institute, there are lots of trials and re-trials of tuber and crops experiments, and as such funds are needed for crops at various trial stages and when the funds are not provided, it affects the entire trial process.[8] Most of the time, this situation degenerates to late planting of seeds on the Institute's demonstration farms and trial farms. This has been known to cause serious setbacks for the Institute. This is because times and seasons are very important in the trial and experimental processes and whenever crops miss their appropriate planting time, it affects the entire experimentation process.[9]

Lack of Water

Different Executive Directors have at one time or another identified measures aimed at reducing water problem in the Institute. Several boreholes have been sunk for different departments but they are not enough to serve the Institute as most of the laboratories have no good water supply.[10] This lack of water supply also affect dry season farming in the Institute, much more as the irrigation system at the does not supply water all round.

Farmers Inconsistencies with Research Findings

Majority of rural farmers in the agro ecological zone are either illiterate or have low level of education. And as such, they cannot easily understand that seedlings have improved varieties.[11] To many in this category, it is a new slogan used by the new generation farmers.[12] They tenaciously hold on to their old farming methods such as use of local varieties, non use of pesticide, among others.[13] This situation is at cross purpose with the new innovations most of the time. Majority of them are of the opinion that improved varieties contain a lot of chemicals and as a result reduce soil fertility.[14] At others times, those who accept them do not adhere to the Institute's farming system.[15] For instance, in the case where farmers are asked to put in only one stem cutting of cassava in the mould, most of them feel that it is a waste of materials and land, and as such do not follow the techniques given to them by the research scientists for increased crop yields.[16] As a result, negative outcomes inimical to development of agriculture are experienced.

Human Resource/ Capital Development

Overtime the Instititute has witnessed poor human resource which reduces agricultural research. From time to time, vacancies are created with the retirement of older staff, they are often hijacked by politicians who fill in these vacant positions with their brothers and sisters, irrespective of the area of need[17]. For instance, when the only virologist at the Institute died sometime ago, the Institute duly notified the supervising ministry. It was alledged that following this, a number of recruitments were made with no virologist recruited for the Institute. This resulted in packing the work which he would have done to sister institutes. Thus delaying that aspect of work at the Institute resulting in putting cracks in the smooth running of the Institute.

In line with the above, the Institute is being faced with inadequate staff development programme. Prior to 2000, the institute had staff research development programme for training and re-training of scientists, aimed at boosting the quality of the research scientists.[18] However in the recent past, this training has not been carried out, past executive directors blame it on short fall in the internally generated revenue. Any research officer that require research update either finance their individual attendance to these conferences or is left to face depriciation and this has greatly reduced research output.

In addition, the newly Federal government introduced rationalization policy in the civil service, of which the Institute is one of them has left much to be desired.[19] This scenario has culminated in the ban on new staff recruitment; leaving a situation whereby younger zealous scientists are no longer recruited. Thus, creating a gap of human resource development. This has given rise to lack of mentoring of more experienced researchers on their way to retirement on upcoming scientists.

Inadequate Power Supply

Research business needs constant power supply. A researcher could stay for many days, weeks, months or even years trying to resolve just an issue, and as such needs electricity to enable him/her conduct the research. For instance, the Biotechnology Department is known to suffer from constant power supply. This power outage normally inhibits the use of some chemicals that require 24-hour refrigeration to carry out research in the Institute.[20] This development is known to further slow down the tempo of work. The situation further adds burden to the output thereby making the institute's products very expensive for the farmer.[21]

Dependence on Collaborators' Funding for Research Output

By the 1980's, funding of agricultural research institutes in Nigeria was a collaborative venture between the state, federal governments and the private sector, with the federal government having an upper hand in its funding as a result of the oil boom of the period, which after turned into the oil doom and its adverse effect on the Institute. The amount of fund released by the federal government at that time had consistently fallen short of the Institute's budget. Arising from this, the donor agencies became the messiah, and provided the bulk of the budget estimates to facilitate research activities. This situation turned the federal government of Nigeria into a sleeping partner.[24] This as a result gave rise to a state of helplessness and any time these agencies withdrew support of any project, the withdrawal automatically becomne the end of the project. This invariably meant that no project could be brought to a logical conclusion without the donor agencies.

Late Execution of Approved Project

Projects approved for the Institute by the supervising ministry are not promptly executed. When projects are sent to the ministry, it normally take more than one year to finally get approval and another year before commencement.[25] For instance, reports have it that in the recent past, the approval given for the construction of an ultra-modern laboratory for the biotechnology programme and refurbishment of the other laboratories in the Institute, took the contractor five years to complete the projects, and this ultimately stagnated the activities at the institute.[26]

Inadequate Project Vehicles

Part of the institute's activities included supervision of its demonstration farms. This has not been able to effectively take place as sa result of inadequate project vehicles. It is regretstable that an ISnstitute of this magnitude could only boast of about four functioning Hilux project vehicles. This situation is known to hinder effective supervision of the demonstration farms and other projects.[27]

Brain Drain

The Institute is known to have lost some of its best hands in the recent past, due to poor remunerations and inability to access research funds. Prior to this time, the Institute had paid allowances to its researchers, enabling it put their salaries at par with their counterparts in the universities.[28] Since the removal of allowances it is on record that more than 10 PhD holders have left the Institute for other sectors of the economy. Some left to join the business world, while others left the shores of the country for greener pastures.[29] In fact, brain-drain syndrome has greatly reduced research output in the Institute.

Management Leadership Style

Leadership styles of the executive directors of the Institute affected the quality of research output. Over the years, some executive directors were research friendly, using part of their internally generated funds to sponsor research and gave bonus as incentives to boost the morale of the staffs,[36]others were selfish and awaited unending research grants from the federal government before quality research could be embarked on. As a result, the mandate of the Institute was not effectively achieved when the human resources were poorly managed[37].

Non-Effective Extension Service Programme

The extension service programme of the Institute does not have wide extension delivery service to cover all the areas of the agro-ecological zone.[38] For instance, the Institute concentrates their school and village outreaches in and around Abia State and Umuahia in particular, creating a scenario where other areas in the zone are not in tune with the activities of the Institute, due to poor extension activities. This results in transfer of few of the Institutes' technology to few farming communities.[39]

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4. C.N Egesi, 57 years, Director Biotechnology programme, interviewed at his office at the National Root Crops Research Institute Umudike, 08/06/17.
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6. E.O. Mbanaso, 50 years, Executive Administrative Officer, interviewed at her office at the National Root Crops Research Institute Umudike, 13/02/17.
7. O.C. Aniedu, personal interview, 20\03\17.
8. C. Aniedu, 58 years, Director Post Harvest Programme, interviewed at her office at the National Root Crops Research Institute Umudike,18/06/17.
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25. G.N. Asumugha, 56 years, Director Extension Service Programme, interviewed in his office at the National Root Crops Research Institute Umudike, 13/02/17.
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27. E.O. Mbanaso, personal interview, 13\02\17.
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31. A.I. Ukandu, personal interview, 18\06\17.
32. O.C.Aniedu, personal interview, 20\03\17.
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37. O.C.Aniedu, personal interview, 20\03\17.

38. O.C.Aniedu, personal interview, 20\03\17.

39. O.C.Aniedu, personal interview, 20\03\17.

CHAPTER SEVEN

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

Agriculture continues to be an important sector in the Nigerian economy. This is perhaps why it has always been relied on for the provision of food, raw materials and employment for the growing population. This has made the sector critical in Nigeria's march towards economic self reliance. The various attempts by previous governments in Nigeria aimed at developing and reforming the sector, attest to this fact. Thus, as a result of the importance attached to this sector by the governments, efforts have been made to expand and modernise agriculture with a view to increasing its agricultural productivity and enhancing the food security in the country. In spite of these efforts, the demand for food production does not appear to meet domestic needs let alone meet export requirements of the country. Under the grave situation, two options were open to the country. One was to increase the size of the farmland and the other was to increase the yields of per unit area. The latter was realised through the utilization of the results of agricultural research. Agricultural research in Nigeria therefore started formally with the establishment of a botanical garden in Lagos in 1898,[1] which was a part of a network of gardens established under the British rule, focusing on the introduction of new crops. This was followed by the establishment of a forestry and botanical department, which was later known as the Agriculture Department for Southern Nigeria, and was further divided into two regional departments which were departments of Northern and Southern Nigeria; both were unified in 1914 as a result of the amalgamation in 1914.[2]

Over time, progress was made in terms of new research stations and further research continued to focus on export of crops like cotton, cocoa, among others. Agricultural research institutes were established in an attempt to bring about a meaningful agricultural development. These agricultural research institutes were known to conduct researches into better ways of cultivation, farming and more economical ways of producing crops, high quality planting materials, among others. At the time, agricultural research in Nigeria consisted largely of research and experimental sections of the defunct federal department of agriculture with headquarters at Moor plantation, at Ibadan. The Moor Plantation, as it were, served as an experimental farm for Nigeria for the propagation of cotton and other crops. Thus, in order for it to serve its capacity fully, its activities were extended to other adjoining provinces including eastern provinces, where Umudike was chosen, as a training station.[3]

The history of the National Root Crops Research Institute , Umudike ,can, therefore, be traced to January 1st 1923[4], as a provincial research farm of the Moor plantation, Ibadan. Since then, it has undergone thorough developmental processes, including regionalisation in 1955[5] and a subsequent update as an agricultural station under the auspices of the Director of Agriculture of Eastern Nigeria with headquarters at Enugu, thereby serving the agricultural research needs of the region. The farm later became known as the Eastern Nigeria agricultural research station in 1956, and by 1965 it was renamed the Eastern farm.

The independence of Nigeria in 1960 opened a new chapter for the station, following the development of a new partnership, whereby the United States Agency for International Development (USAID), was to broaden its scope of activities. However the outbreak of the Nigerian civil war in 1967 was to truncate this envisaged growth.[6]

With the 12 state structure of the country, the Institute came under the East-Central State Government, and by 1972, the federal government took over the station and renamed it the Federal Agricultural Research and Training Station (F.A.R.T.S). It was further upgraded to a commodity research institute in 1973.[7] In 1976, the Institute was renamed National Root Crops Research Institute, Umudike. With this development, the Institute came under the Agricultural Research Council of Nigeria.[8]

The study area, Umudike, is a town in Ikwuano LGA of Abia State, surrounded by some villages: Umuariagha, Umuokwo, Amawom, Umughalu, Amabe Ime, Nono among others.[9] The institute has mandate to improve on root and tuber crops such as yam, cassava, cocoyam, sweet potato among other crops. It conducts research into the genetic improvement of economically important root and tuber crops as listed above, crop cultivation techniques, storage, processing and utilization of the crops, concentrating on requirements of farmers in the South-east zone of the country, runs a diagnostic survey of the farming systems in the zone to obtain information on status of agricultural activities and to identify production construal and opportunities, conduct of up-stream (out station) activities, research to tailor down commodity research result to suit farmer's conditions, conduct Monthly Technology Review Meetings (MTRMs), where scientists from the institute train the subject matter specialist from the various state Agricultural Development Programme(ADPs), on improved technologies, provided training of middle level agricultural workers, helped in the development and transfer of production packages- crop varieties, optimum spacing, optimum rate and time for fertilizer application, weed control measures and crop compatibilities, stacking methods in yam based systems, harvesting for maximum productivity in technologies, weed control in root and tuber crops- based mixture,

development of complementary use of both cassava composite meal with commercial feed in the feeding of broilers and laying birds.

The constraints of the Institute include inadequate funding, late release of funds, lack of water, farmers inconsistency with research findings, lack of adequate personnel/ research scientist, inadequate power supply, dependence on collaborators funding, late execution of approved projects, inadequate project vehicles, inadequate farm implementation, brain drain, inadequate overhead allocation, inadequate concrete staff development programme, embargo on new employment, management leadership style, non-effective extension service programme, among others.

Conclusion

Agriculture remains the mainstay of the Nigerian economy in terms of national output and employment generation. The research institute has developed numerous technologies and innovations in its mandate crops, but ironically, most of its research findings are not utilized by farmers, who are the main target group. Agricultural research, in terms of national agricultural development would not be meaningful if their results neither get to the end users nor get accepted by the majority of the farmers[10].

The improved research seedlings are not commercially produced, there were no mass production for the improved varieties and seeds, and this was attributed to lack of sufficient funds to the Institute[11]. The produced improved varieties end up in the hands of very few farmers, which are very insignificant compared to the number of farmers in the agro-ecological zone. Most of the time, the new innovations were so expensive that the common rural farmer would not afford them; this situation made mockery of the research findings and the activities of the research institute.

The farming systems and extension divisions of the Institute have not done a ground work in the dissemination process; it has not developed an effective means of disseminating the institute's innovations. Most of their programmes are concentrated around Umuahia in particular and Abia State in general.

The underfunding of the State Agricultural Development Programmes also affected the institute's dissemination process, as most ADPs are dormant as a result of underfunding by the state governments, and as such they are not doing their extension responsibilities very well. Most of them have not been consistent in attending monthly review meetings, where most of the institute's technologies are taught and trainings organized. Consequently, the fortnightly review meetings with the local farmers do not take place. This poor extension mechanism has greatly affected the institute's output. For any nation to be self sufficient, she must employ progressive agriculture and this can only be possible if the institute and government should play their roles in providing incentives for modern agriculture, which would eventually increase agriculture and productivity in the nation's economy.

At the end of the day, the research was able to establish, based on the facts gathered during field trips and other sources of information, that the Institute has been able to justify the aims and dreams of its founding fathers. To a large extent, the success achieved by the Institute has reasonably fulfilled the Structural-Functional Analysis which in the words of Gabriel Almond, the proponent of the theory, states that every political system has specific functions to perform. In other words, each political system is different from the other through the function it performs. In the case of the Institute, it was observed in the course of the research that 90 per cent if not all the departments cooperated with one another to maximally achieve a definite goal, which is now a success story told in this research.

Recommendations

- Government at all levels must be prepared to take the lead and play the central role by investing massively in the development of the institute. The institute's through adequate funding goes a long way at dictating the pace of the agricultural development and the economic development of the country. Government should not renege on its duties and constitutional responsibilities of ensuring the country's food security through the research institute.
- There should be strong implementation of the Research Extension Farmer Input/ Marketing Linkage System (REFILS) in the agro-ecological zone to boost the downstream activity. In line with this, the state governments should as a matter of urgency fund the ADPs to enable them function effectively.
- There should be commercialisation of improved varieties and other technologies developed by the institute. It has been agreed that the institute is under-funded, and as such cannot shoulder this huge financial obligations; they could obtain loan from the Agricultural Development Banks or partner with other commercial banks to finance the project. When these improved seedlings are sold, the loans would be paid back from the sales at the end of the farming season, instead of allowing most of the new technologies to waste on the shelves of researchers. Also in the area of production and marketing of farm machinery, tools and equipments, they could collaborate with steel manufacturing industries to develop these materials which are capital intensive, and by so doing, provide gainful opportunities for private sector initiatives.

- Improvement in down-stream agricultural commodity activities, the institute's activities encompassing crop planting and harvesting constitute down-stream agricultural commodity activities, from which primary commodities emerge. These post harvest activities are important in adding value to the primary products, improving its quality and thereby making it less perishable. Most of the activities of this programme end up in its shelves, the programme could partner with food manufacturing companies and commercialise their products. For instance, the orange fleshed sweet potato drink could be commercialized. While the Institute has the research procedure, the company will have the necessary marketing tactics.
- Government increased support of the Institute's extension. There is need to strengthen agricultural research activities through increased and stable proper funding, proper coordination and strengthening of linkages of the Institute. Social media should be used to boost linkages system to get the institutes' messages to the right people, as they have the potential to make research output much more accessible. One could argue that the majority of farmers in Nigeria are uneducated and may not have access to android phones, while this may be true, we should understand that some of the farmers' children are in possession of these phones and could easily pass these informations to their parents, who in turn pass it across to their fellow farmers. This can be done by creating awareness by raising the profile of the institute's projects, events and activities using the social media to establish the institute's reputation in the research and development arena. Blogging for impact could also be a good way for researchers to share their research ideas with others and gain feedback from the wider online audience. The social media could promote issues that resonate with people to support its cause, form strategic alliances, create an environment where people

recognise its expertise and establish the institute as the expert in its field of research. In addition, communication of research output could be made better by adjusting the content to fit social media tools, reaching out to interested people outside the institutes regular circle and gain valuable ideas and feedback from the pool of social networks.

- Government should remove embargo on employment for research institutes because new ideas is of prime importance for research improvement and development, so new breeds and young people should be incorporated into the system. When this happens, mentoring of the younger research officers will take place, and when the older scientists retire the institute will not find it very difficult to continue the free-flow of research process.
- The leadership of the institute should carry the staff along in their management decisions. The respective union representatives should be kept abreast with management decision processes.
- Funding of the institute needs to be enhanced by the federal government due to the fund driven nature of research conducted by the institute. External funding could only come in for complementary funding to the institute, as such, they will not be made to carry the bulk funding of the institute. The institute could supplement their funding through establishment of revenue yielding ventures and projects like guest house. Establishment of cottage industries, consultancy services among other things are veritable means of raising more funds needed to enhance quality service of the institute.
- The government at all levels should be part of the funding of the institute. The government should adopt reasonable budgetary expenditure. In addition, there could be complete private sector participation or public private partnership. Government should borrow a leaf from the World bank initiative of supporting donor to the institutes activities.

- The management of the institute must be prudent with the meager funds released to them by the government as well as in the internally generated funds. The issue of corruption in the management of funds of the institute and high handedness of the executive directors should be properly addressed. Any staff found wanting in wasting of funds or mismanagement must face the full wrath of the law. In this regard, the independent corrupt practices and other related crimes commission should always investigate corrupt practices in the institute.
- Working conditions and staff welfare must be of paramount interest to the management of the institute. The staff especially the research scientist must be motivated through adequate salary and allowances. Salaries of workers should be paid as at when due, along with timely promotions. Other motivational packages should also be employed and they could be in the form of loans for car, housing, school fees and insurance. It goes a long way in increasing staff productivity and quality assurance.
- There should be at least once a year audit of the institute; this will help to instill discipline in the management of the institute, and adequate measures taken should be taken to get the money back from the culprits, in-fact the Independent Corrupt Practice and other related Crimes Commission should always investigate corrupt practices in the Institute.
- There should be more collaboration with other research institutes for the dissemination of the innovations of the Institute, this collaboration should also be extended outside the shores of the country.
- There should be adequate training and re-training of the research scientists, to keep them abreast with current innovations and research processes. Resource persons should be attracted from reputable foreign research institutes who are far more advanced in agricultural research. Not only that, there should be a follow-up on the teachings and trainings, this could

only be made possible through provision of research grants to carry out quality work, got mainly from the Institutes internally generated revenue.

- Government and public partners should endeavour to provide functioning generating sets located at strategic places within the institute as an alternative source of power supply. In the same vein, philanthropists, private and cooperate bodies should as a matter of urgency assist the Institute in order to reduce their financial constraint.

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2	Amanze, C.N.	47yrs	Resource Scientist Cassava Research Programme	National Root Crops Research Institute Umudike	27/02/17
3	Aniedu, C.	58yrs	Acting Director Post Harvest Programme	Michael Okpara University of Agriculture Umudike	18/06/17
4	Aniedu, O.C.	63yrs	Deputy Director Planning	National Root Crops Research Institute Umudike	20/03/17
5	Ano, A.O.	62yrs	Director Cassava Research Programme	National Root Crops Research Institute Umudike	27/02/17
6	Arumeh, .K.	45yrs	Farmer	Ubaha Oriendu Umuahia	23/06/17
7	Asumugha, G.N.	56 yrs	Director Extension Service Programme	National Root Crops Research Institute Umudike	13/02/17

8	Chinaka, E.C.	60yrs	Farmer	Amawom Umuahia	17/07/17
9	Chukwu, G.O.	57yrs	Lecturer Soil Science Department	Michael Okpara University of Agriculture Umudike	26/03/17
10	Echendu, T.N.C	68 yrs	Retired Post Harvest Programme Director.	National Root Crops Research Institute Umudike	12/08/17
11	Egesi, C. N.	58 yrs	Director Bio-technology Programme	National Root Crops Research Institute Umudike	13/02/17
12	Ekeledo, T.O.	55yrs	Research Scientist	National Root Crops Research Institute Umudike	20/06/17
13	Eke Okoro, O.N.	62yrs	Director Yam Research Programme	National Root Crops Research Institute Umudike	27/02/17
14	Ekwe, C.O	60yrs	Director Framing System Research Programme	National Root Crops Research Institute Umudike	24/05/17
15	Ene, L.S.O.	80yrs	Retired Executive Director	Uwani Enugu	30/06/17
16	Ezebuiro, N.C.	51yrs	Research Scientist supervisor Amawom Adopted Village	National Root Crops Research Institute Umudike	13/06/17
17	Igbojiekwe, C.	48yrs	Farmer	Ibeku Umuahia	24/05/17

18	Ironkwe, A.	59yrs	Director Minor Root Crops Division	National Root Crops Research Institute Umudike	30/03/17
19	Mbanaso, E.O.	50 yrs	Executive Administrative Officer	National Root Crops Research Institute Umudike	13/02/17
20	Merendo,. A.	90yrs	Retired civil Servant	Ndume Ikwuano LGA	08/06/17
21	Nkere Chukwuemeka	44yrs	Research Scientist	Biotech Programme National Root Crops Research Institute Umudike	08/06/17
22	Njoku, J.C.	58yrs	Assistant Director Sweet Potato Programmes	National Root Crops Research Institute Umudike	24/05/17
23	Nnodim, U.K.	54yrs	Soil Scientist Soil Science Department	National Root Crops Research Institute Umudike	28/06/17
24	Nwangumah, C.O	50yrs	Farmer	Agricultural Development Programme Umuahia	26/08/27
25	Nwosu, K.I.	68yrs	Retired Executive Director	Ikwuano Umuahia	15/10/16
26	Nwosu, C. U.	57 yrs	Programme Coordinator	Agricultural Development Programme Headquarters Imo State.	30/06/17

27	Ochiagha, E.A.	57 yrs	Farmer	Ndume Umuahia	12/08/17
28	Okereke, U.K.	55yrs	Post Harvest Programme	National Root Crops Research Institute Umudike	13/06/17
29	Okochi, Joy	50yrs	News Presenter (public servant)	Imo Broadcasting Cooperation Owerri	28/07/17
30	Okorie, I.W.	53 yrs	Research Scientist	National Root Crops Research Institute Umudike	13/06/17
31	Okorie, I.O.	90 yrs	Retired Civil Servant	Ikwuano Umuahia	12/11/16
32	Ololoh, K.O.	89yrs	Retired Principal School of Agriculture Umudike	Olokoro Umuahia	15/08/16
33	Onochie, E.E.	80 yrs	Retired Executive Director	Onitsha	20/06/17
34	Onuoha, .C.	48yrs	Research Scientist supervisor Ubaha Oriendu Adopted Village.	National Root Crops Research Institute Umudike	05/06/17
35	Onyeka, J.	60 yrs	Director	National Root Crops Research Institute Umudike	18/03/17
36	Ukandu, A.I.	57yrs	Principal Administrative	National Root Crops	18/06/17

			Officer	Research Institute Umudike	
37	Ukpabi, J.U.	64yrs	Acting Executive Director	National Root Crops Research Institute Umudike	24/03/17
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APPENDIX 1

Junior Staff Disposition as at 1976

Agricultural Assistant in TRGL	39
Data Processing Assistant (TRG)	3
Senior Artisan	14
Senior Plant Operator	5
Senior Laboratory Assistant	3
Stores Assistant	6
Potential Stenographer	3
Clerical Assistant	30
Typist Grade 11 & III	21
Telephone Attendant	2
Head Messenger	2
Hall Porter	1
Receptionist	1
Motor Driver	2
Audio Visual Technologist	1
Herdsman Grade	I
Tractor Driver	3
Laboratory Assistant/Laboratory Assistant, in TRG	19
Stock Man GD I	4
Technical Assistant	23

Recorder GD 1	7
Nursery man G.D 1I	7
Artisan GD. II & III	45
Field Attendant	23
Film Projectorist	I
Mill operator	2
Book Binder assistant	1
Library Attendant	4
Messenger	14
Store man	8
Clinical Attendant	3
Cook	4
Dispensary Attendant	1
Agriculture Home Economics Attendant	1
Senior Laboratory Attendant	15
Nursery man Grade II	19
Grounding gardener	9
Recorder Grade II	18
Duplicating Machine Operator	4
Dark Room Attendant	2
Cleaner	8
Gesterner attendant	1

Watchman	30
Permanent Labour researcher	45
Casual Labour researcher	135

Source: Planning and Administrative Division, National Root Crops Research Institute Umudike, Abia State, 1976, 4

Appendix 2

Staff Strength by Cadre 2014

Research Officer	189
Lecturer	0
Librarian	6
Laboratory Officer	6
Affair Officer	122
Accountant	56
Planning Officer	8
Library assistant	0
Data processing officer	6
Information Officer	20
Engineer	7
Estate officer	6
Technical officer	9
Graphics arts Officer	2
Superintendent of Press	0
Medical officer	1
Nursing Officer	5
Nursing Superintendent	1
Secretary	21
Secretarial Assistant	4

Food Technologist	3
Science Lab Technologist	22
Higher Assistant Education Officer	0
Education Officer	0
Laboratory Technician	10
Laboratory Foreman	1
Press Attendant	6
Stores Officer	4
Store Keeper	6
Agricultural Superintendent	90
Works Superintendent	29
Executive Officer Accountant (Audit)	7
Executive Officer (GD)	3
Executive Officer (NFO)	6
Meteorologist	10
Field Superintendent	10
Field Foreman	1
Livestock superintendent	2
Agricultural Field Overseer	262
Agricultural Field Attendant	59
Statistician	3
Motor Driver	35

Commercial Officer	2
Tractor Driver	11
Clerical Officer	51
Security man	73
Data Processing Assistant	15
Dispensary	5
Foreman/ Artisan/ Craft man	76
Film Editing Assistant	1
Photographic Assistant	2
Catering Assistant	5
Teacher Headmaster	8
Programme Analyst	1
Information Assistant	8
Instrument Technologist	5
Optometrist	1
Technical Assistant	4

Source: Planning and Administrative Division, National Root Crops Research Institute Umudike, Abia State 2014, 6.