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Research and Development on Agricultural Productivity.

Case of Cassava in MANYU Division.

END OF STUDY THESIS AS FULFILMENT FOR THE AWARD OF A MASTERS DEGREE IN ENVIRONMENTAL AND RURAL DEVELOPMENT ECONOMICS

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Dedication

To My Parents: Mr. Ebot Peter Nchong and Mrs. Nchong Magdalene Ntui

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Many researchers as well as academicians have played decisive roles in the field of research and development within the agricultural sector and to be specific in a staple crop like cassava.

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ABBREVIATIONS

R&D: Research and Development

SSA: Sub Saharan Africa

IITA: International Institute of Tropical Agriculture

IRAD: Institute of Agricultural Research and Development

TMS: Tropical Manioc Selection

CMD: Cassava Mosaic Disease

CBB: Cassava Bacterial Blight

QTL: Quantitative Trait Loci

GNP: Gross National Product

GCDS: Global Cassava Development Strategy

COSCA: Collaborative Study of Cassava in Africa

AIS: Agricultural Innovation Systems

IFAD: International Fund for Agriculture and Development

FAO: Food and Agricultural Organization

CGIAR: Consultative Group for International Agricultural Research

CIAT: International Center for Tropical Agriculture

NIS: National Innovation System

CNRSA: National Council for Applied Research

CTFT: Technical Centre for Tropical Forestry

IRAT: Research Institute on Tropical Agriculture

ONAREST: National Office for Scientific and Technical Research

HYV: high-yield seed varieties

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Abstract

The research thesis seeks to analyze determinants of cassava productivity within the division of Manyu found in the South West region of Cameroon and how it can be used as a tool towards enhancing the livelihood of rural dwellers. We carry out a survey by administering 300 questionnaires to farmers from 19 villages in Manyu division. We run a simple logistic regression to identify determinants of cassava productivity. Results show that education and knowledge of innovative cassava variety increases productivity. As policy suggestion, enhancing the empowering of cassava farmers should contribute towards increase productivity in Manyu division.

Key Words: Research and development, Productivity, and Cassava cultivation.

CHAPTER ONE

GENERAL INTRODUCTION

Section 1: Context, problem statement and research goals

1.1. Context and the problem statement

The important of agriculture in present day economies remain preoccupying as population increase continue to unleash pressure on food resources. The obligation to feed this increasing population warrants governments, international organizations and other actors to carve out means of increasing agricultural productivity. Agricultural productivity can only be achieved through increase in innovation systems that will spike research and development (R&D) through improved agricultural methods (Mechanized), improved varieties, enabling environment by putting in place organizational, institutional and policy framework, financing and marketing. Thus, the expected earn of R&D will make sense only when all these mechanisms are given due attention.

The interaction of agro ecological and economic differences has brought about numerous challenges and limits as to an extent to which technologies in agriculture can spread between and within world regions. There are technologies that can easily spread meanwhile others are dependent on sites. Beginning with Griliches (1957), a voluminous literature aims to analyse and predict technology diffusion across farms, states and countries. Understanding spill over is particularly important when technologies spread across political jurisdictions. Such cross-border externalities could help explain persistent under-investment in both public and private research, particularly for new technologies that spread easily outside a government's political constituency, or outside the reach of a private firm's ability to appropriate benefits through technology licensing or input sales. These problems are likely to be especially severe for easily-copied innovations that use few purchased inputs.

To Paul David (1966), he explained the aggregate diffusion of mechanized reapers in terms of the proportion of a given region's farmers for whom adoption was profitable, given their resource endowments and local relative prices. Many contemporary studies emphasize the profitability of new agricultural technologies as a significant factor affecting long run aggregate adoption patterns, which are in turn influenced by the spatial variation in resource endowments, e.g. climate and agro-ecology, and socio-economic factors, e.g. population density and proximity to input and output markets (Feder, Just, and Zilberman, 1985; Pender et al. 2001). While adopter diversity in resource endowments and relative prices is a key explanation for the typically observed S-shaped adoption curve over time, it is not the only one.

Factors such as: adequate information dissemination (Arrow 1962; Mansfield 1968); access to wealth or credit; risk aversion (Feder, Just, and Zilberman, 1985); supply factors with respect to the intrinsic characteristics of the technology and its generation process (Olmstead, 1975); and imitation or learning-by-doing processes (Foster and Rosenzweig 1995; Conley and Udry 2002), are just as important. Generating and applying new knowledge is important for all enterprises, including farming. But, quite often, new knowledge that can enhance productivity, competitiveness, and sustainability in farming is not widely adopted at scale. This lack of innovation in agriculture has led to the search for new frameworks such as 'innovation systems' that help in understanding how the process of agricultural innovation takes place and how its relevance and quality can be enhanced.

An innovation system is nothing more than a metaphor to help understand the process of innovation, and to help consider how capacities for innovation can be developed. Though originally developed to understand industrial innovation, this framework has been increasingly used to understand the process of knowledge generation and use in agriculture. Recent research has resulted in new and better understanding of the structure and functions of the agricultural innovation system (AIS), which is defined as "a network of organisations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organisations into social and economic use, together with the institutions and policies that affect their innovative behaviour and performance".

This interactive system is made of individuals and organisations that demand and supply knowledge, as well as the policies and mechanisms that affect the way different agents interact to share, access, and exchange knowledge. Under the AIS, innovation is not only concerned with technical innovation (e.g. adoption of a better variety). It also entails organisational innovation

(e.g. organisation of farmers as groups) and institutional innovation (e.g. addressing uncertainties in land leasing through policy changes). Donors and national governments currently recognise the importance of enhancing the capacity of all actors in the AIS instead of just research or extension. This arises from the realisation that neither research knowledge nor extension activities alone drive innovation. There is greater emphasis on investing in strengthening the capacity to innovate or the process through which different types of knowledge are combined to address specific issues.

Basically, the purpose of farmers to crop their land is to obtain a high crop yield and hopefully a high income. De Graaff et al. (2008) in his review of soil conservation work in five countries concluded that generalization of the influence of technology adoption is impossible; therefore, the second key of land husbandry is that the technology developed should meet the farmers' needs and conditions.

Farmers themselves are the persons who know exactly what their problems, their conditions and what their needs. Consequently, the farmers should be given a chance to express widely what their problems, willingness, idea and needs. Basically, the approach is based on the interaction between target audiences (farmers) with researchers or extensions workers. The farmers should be actively involved from the beginning of the technology generation process i.e. to identification of the problems to possible solutions to test and choose the best technologies according to their criteria. With some success, this method has been practiced in many works of agricultural technology transfers and extension with a variety of names such as participatory technology development (Fujisaka, 1989), farmers' participatory research (Utomo et al., 1998;), participatory approach.

Evidence shows that the agricultural sector employs about 70% of the total labour force in SSA, with the majority of these people located in the rural areas (Fiszbein, Kanbur, & Yemtsov, 2014). Agriculture in SSA is characterized by low productivity emanating from the over-reliance on traditional farm technologies. Another factor in the poor performance of the agricultural sector is low investment. Christiaensen, Demery, and Kuhl (2011) point out that most SSA countries allocate a low percentage of their national budgets to the agricultural sector. This issue has become a concern for the African Union (AU), which has compelled its member states to allocate not less than 10% of their national budgets to the agricultural sector.

Most SSA countries are still struggling to achieve a sustainable supply of food commodities such as roots and tubers, cereal, and grain crops. Consequently, rural poverty, food insecurity, and unemployment rates are high in these countries. For instance, the FAO, the IFAD & the World Food Programme (2015) report reveal that about 759 million people in the world are undernourished, 20% are located in Africa, 14.2% in Oceania, 12.1% in Asia and 5.5% in Latin America/the Caribbean. Furthermore, 23.2% of the population in SSA is food insecure. Forty-eight percent (48%) of people in SSA live on $1.90 a day, suggesting that poverty is prevalent (World Bank, 2013). These statistics clearly indicate that Africa is lagging behind in achieving a sustainable food security and alleviating poverty. These economic problems have drawn the attention of policy makers and donor agencies to design and implement agricultural programmes to help transform rural economies in SSA, and more importantly in Cameroon, where most people depend on agriculture for their livelihoods.

Statement of the Problem

The rising need to curb world hunger coupled with global task to reduce poverty especially in poor countries like Cameroon where o ver 40% of the population live on less than one dollar a day, increases the need to boost investment within the agricultural sector which employs over 60% of the population. This population mostly affected by poverty live in rural areas that has poverty levels of over 65% in Cameroon. Cassava whose value have witness much importance in recent times therefore deserve more focus to play this role.

Looking deeply in the ways through which research results and products are made available to end users, its effectiveness remains questionable. A few rural communities mostly those close to research centers benefit meanwhile local farmers in the hinterlands are left at their own mercies. This therefore create gaps and lapses for these farmers even when there are numerous opportunities for improvement especially in Manyu Division in the south west region of Cameroon.

Manyu division is endowed with good climate and rich soils for the cultivation of cassava with good roads following the tarring of Bamenda-Mamfe-Ekok and Kumba-Mamfe stretch of roads which are all linked to Nigeria that have already available market for cassava products. However, studies have shown that there has been an increase in the demand for cassava products from Nigeria and other internal markets from Douala and Bamenda, but this demand has been met by falling output and subsequently a fall in the income of rural farmers generated from this sector. This research thesis therefore seeks to investigate what efforts have been put in place in terms of research and development to improve on the productivity of cassava in Manyu and Cameroon as a whole, as well as agricultural sustainability.

Section 1.2 Research Question and objectives

Main research question

The main question in this study is to what extend has agricultural innovation increase in cassava productivity in a rural setting like the Manyu division?

Specific Research Questions

1) To what extend has Innovation actively contributed to cassava transformation in Manyu through the adoption (usage) of improved varieties?
2) Which tools that influence farmers' perception and decisions in the usage of innovative systems in the cassava sector in Manyu?

Research Objectives

Main Objective

To assess to what extend has agricultural innovation increase in cassava productivity in a rural setting like the division of Manyu.

Specific Objectives

1) Analyse the relationship between innovation and cassava transformation in Manyu through the adoption (usage) of improved varieties?

2) Identify tools that influence farmers' perception and decisions in the usage of innovative systems in the cassava sector in Manyu?

Research Hypothesis

The main research hypothesis is that innovative cassava varieties increase cassava productivity more than education in cassava cultivation in a rural setting like in the Manyu division Manyu division.

Specific Hypothesis

1) Rural farmers with higher education adopt innovative and cassava transformation more than lowly educated rural farmers.

2) Perception affects the adoption of cassava variety more than the system or farming technic adopted by the farmer.

Section 2: Methodology, Contribution and outline of Thesis

2.1. Methodology and Data presentation

The methodological approach in this work combines both field work and basic analytical tools to (1) review the evolution of cassava variety and (2) identify the causal relationship between adopting cassava innovative varieties and increase cassava productivity. We use descriptive statistics, area review and basic econometric (logistic regression) to study this relationship. A Specific case analysis is carried out in selected villages in some sub divisions in Manyu, to ascertain farmers' attitude towards the decision to adopt improved varieties of as well as its effects on productivity.

Data used to carry out this study is typically from a rural setting. A total of Nineteen (19) villages where selected. And 300 questionnaires distributed and supervised with questions ranging from; demographic and economic factors that affect the use (adoption) of improved varieties of cassava. Data analysis is carried out using a logit regressive model.

2.2. Research Contribution and organization of thesis

This thesis contributes to the area of R&D efforts towards agricultural productivity especially in rural areas. Specifically, it discusses the farmers' attitudes towards the use (adoption) of improved varieties of cassava within a typical rural setting like the Manyu division. We contribute in providing information on: (a) how rural farmers can readily adopt new crop varieties (cassava) once they are convinced about its benefits, (b) the role of perception and information in creating awareness amongst local farmers about new cassava varieties and its availability and (c) the role of some demographic and socio economic factors towards farmers attitudes in adopting new crop varieties in rural areas.

International and national policies be it at the public or private sectors has a great part to play in ensuring the putting in place of innovative systems. Concepts and ideas developed in this study is a pathway contribution to task stake holders in private and public sectors, to take action towards ensuring that research and development efforts is encouraged in attitude adoption of rural farmers. A bottom top policy approach is adopted in this study to verify for the robustness of the policy definition of how adequate tools can be defined towards cassava adoption especially in a rural setting like the Manyu Division. This is another contribution of this thesis towards the effective dissemination and availability of improved crop (cassava) varieties.

To attain the objectives set in this thesis, we organize the said thesis as follows. Chapter one outline the objective and statement problem of our research endeavor. Chapter two emphasis on the different literature and knowledge on innovative systems as well as efforts on cassava innovation and adoption. Chapter three presents the methodological tools and framework we mobilize. Chapter four presents the main findings. We then conclude the thesis with a general conclusion.

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CHAPTER TWO

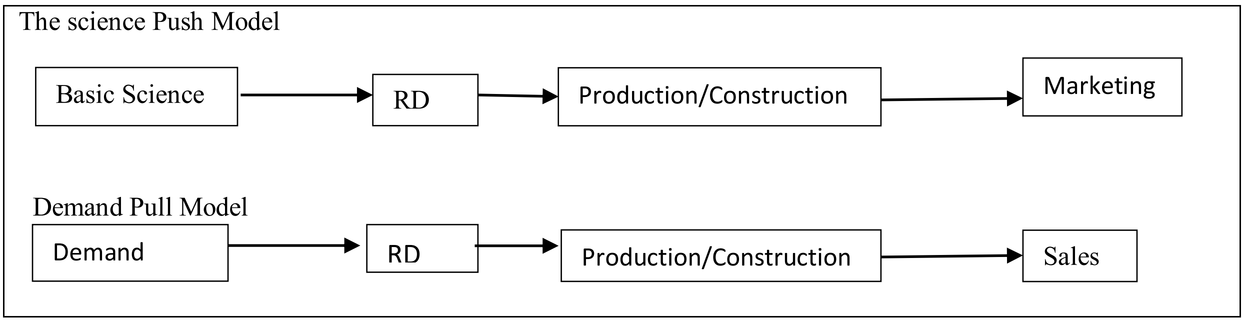
OVERVIEW OF LITERATURE ON INNOVATION AND EVOLUTION OF R&D IN CASSAVA DEVELOPMENT

Section 2.1 Overview of Literature

The notion of Research and development which is as a result of innovation has many facets through which it has been given varied definitions, interest and works. The most dramatic transformation in agriculture was witnessed in the twentieth century. Fast changes in agricultural systems as a result of science oriented agriculture. This led to changes in farms and fast tracked the evolution from subsistence agriculture to more productive and profitable farming. As success in agricultural production surged, it led to specialization in some products or crops. The result was an increase in farmers-led private enterprises and the construction of non-farm private sectors in rural areas. As science oriented agriculture increased, there was an emergence of the private sector engagement in off the farm processing of food, merchant activities involving inputs and other materials, marketing, transportation and other services.

In the 1950s, 1960s and 1970s, analysts of innovation viewed the process of innovation as predominantly linear. The first of this model of linear innovation model was the science push approach. Here, innovation was observed to start with discovery in sciences, passing across invention, engineering and manufacturing and ends with marketing of new products or processes. The second linear model developed was the demand pull model which showed that innovation was being engineered by demand. The table below explains the two models.

Table 2.1 Linear models of the innovation process



Source: Systems approach to innovation studies, Dr. Karen Manley, Vol. 9, No. 2

So many definitions have been brought forward when it comes to the meaning of innovation; Nyamwena-Mukonza (2013) however provides a comprehensive definition which describes it as a continuous enhancement in the design of a product and its quality.

Section 2.1.1 Theoretical review of innovation

A number of theories have merged concerning the role played by entrepreneurship and innovation in economic development, Joseph Schumpeter's (1883 – 1950) view on innovation is considered the best. To Schumpeter, an entrepreneur is seen as an agent of change who introduces a new product or a new method of production (an innovation). The concepts of innovation and entrepreneurship are probably Schumpeter's most distinctive contributions to economics (Sledzik, 2013) . Schumpeter's 'creative destruction' theory views entrepreneurial innovation as a process through which entrepreneurs bring about industrial mutation, where the economic structure is incessantly revolutionized from within; thereby destroying the old system while creating a new one.

Innovations can be defined as new methods, customs, or devices used to perform new tasks. The literature on innovation is diverse and has developed its own vocabulary. We will distinguish between two major research lines: research on innovation generation and research on the adoption and use of innovation. Several categories of innovations have been introduced to differentiate policies or modeling.

Analysis of adoption or the impact of risk-reducing innovations may require the incorporation of a risk-aversion consideration in the modeling framework, while investigating the economics of a shelf-life enhancing innovation may require a modeling framework that emphasizes inter-seasonal dynamics. Dosi (1988) characterizes innovation as a process of search, discovery, experimentation, development, imitation and adoption of new products, processes and new organizational techniques. In a more positivist perspective, for Tidd, Bessant, and Pavitt (2008), innovation is a business advantage able to mobilize knowledge, technological advances and innovations in the provision of products and services.

The concept of radical innovation is part of the theoretical and methodological criteria to characterize innovative performance of an enterprise in an economy. For example, Community Innovation Survey (CIS) conducted by Eurostat (2016) in Europe, as well as Innovation Research – PINTEC performed in Brazil by the Brazilian Institute of Geography and Statistics (IBGE, 2016), both based on the Oslo Manual (OCDE, 2005), explore this attribute – radical eco-innovation, meaning that in the case of the product, whether it is new to the world market, to the national market, or new only to the company itself. In the case of process, whether it is new to the national industry, to the industry in global, terms, or if the process is new to the company itself. As such, radical innovations for the sector will be considered "high innovation rate" and incremental innovations for the sector will be called "low innovation rate".

There are three types of technology partnerships that can offer small and medium enterprises to be more open: (i) business partnerships, (ii) partnerships with government, and (iii) partnerships with research institutes (Najib & Kiminami, 2011). There are two lines that talk about the collaborative process. One is made up of writers who look at the differences between a university and a company, for conflicting purposes. The first line touches on the Sábato Triangle model. Sábato and Botana (1968), formed three ambassadors based on the triangle, emphasizing the government at the highest vertex and at the university and in the company as fundamental elements of cooperation. On the other hand, Etzkowitz (1998) defends the Triple-Helix model, in which, unlike the Sábato Triangle, there is a combination of intentions and relationships between the university and the company.

The key to success is careful consideration of what should be opened, how it can be opened and how you can deal with the new problems created by that opening". The Chesbrough Open Innovation model (2003) is a way, for example, in which businesses plan to seek innovation resources, in partnership with universities and research institutes. Institutions of higher learning are, inter alia, the goal of advancing the knowledge base, and the basic research needs of businesses. Chesbrough, Vanhaverbeke, and West (2006) report innovation as a result of new paradigm revisions, concluding that innovations suggest that what emerges within the business is not limited to the current business model, but rather, have the opportunity to market through various channels.

However, a small commitment is seen in companies and universities to establish flexible and structured relationships based on new production partnerships. The concept of "participatory learning" describes the organisation's ability to transmit and receive information, which is interpreted as training programs (Instituto de Pesquisa Econômica Aplicada, 2005). Collaborative communication channels between industry and research institutes and universities are among the leading actors in the cycle of new strategies for a particular product or service.

Open design offers a variety of options and, hence, Minshall, Seldon, and Probert (2007) consider that external sources of innovation may vary, such as suppliers, clients, strategic partners, universities, research institutes and startups. However, universities and research institutes are unaware of potential customer needs and markets, which require, therefore, partnerships with businesses to fulfill industry ambitions (Feng, Ma, Zhang, & Du, 2013). Communication between the university and the company through the NIS structure faces a variety of barriers, due to different regional or structural interests. The fact is that by overcoming obstacles, the results can be beneficial.

It is important to promote the actions of universities, in their new programs, in order to achieve the organization's investment objectives. Feng et al. (2013, p. 47) conclude that "while in the process of pre-market co-operation such as collaborative development, co-established organizations, and collaborative technology collaborations, research institutes and business have a lasting and close relationship, and information communication, through information that can be created and transmitted through mutual effort". The concept of a National Innovation System (NIS) can be understood as a form of co-operation. Lundvall (1988) and Nelson (1993) think of NIS as systems characterized by different patterns of cooperation.

In reviewing the origins of NIS, a new branch of literature on innovation, called the "National Innovation Systems" (NIS), is a concept developed mainly by Freeman (1987), Lundvall (1988) and Nelson (1993), known as the precursors of the concept. According to Fagerberg, Mowery, and Verspagen (2009), NIS includes not only new companies, but all the capacity for learning and design in the country that examines organizations, universities and research institutes in the pursuit and application of knowledge. Feng et al. (2013) provide the emergence and development of a knowledge-based economy in the need for greater acceleration in product and technology development, where universities and research institutes play an important role in contributing to the development and competitiveness of the NIS.

Bueno and Balestrin (2012, apud Reed, Storrud-Barnes, & Jessup, 2012, p. 69) emphasize that "cooperation allows ideas from outside the region to strengthen the functioning of new businesses". The role of government as a liaison in the process of communication between university and business is important to Baerz et al. (2011), as the university and industry produce in-depth national development activities, which must be managed and planned to generate communication. Such agencies make up a third of the company, university, and government with well-defined roles in the NIS. On the basis of well-written and popular theory of innovation (R&D), the Schumpeterian theory of innovation fits our study in another way called "The Model of Science push".

The role that agriculture played in reducing poverty through technology is very different (Adofu et al., 2013). Growing agricultural productivity is proving to be very difficult without developing and distributing efficient yields that increase technological costs to meet the needs of a growing population to grow the land cultivated or to rely on irrigation (Pender and Gebremedhin, 2006; Datt and Ravallion, 1996). Shideed (1998) identified two common technological improvements. The first is the new construction of a production function as the main result is obtained from a given input level. The second asset is that technological advancement must increase the company's discounted profits (or reduce losses).

Adopting new technologies usually involves two phases: the decision to accept or not and the second phase involves how much new technology to use or use (or the size of the adoption). Farmers will never accept innovation if output does not increase from the supplied resources, and / or if inputs are not reduced to output (Heady, 1952). The adoption of agricultural technology is often a successive process. Farmers can apply new technology to part of their land first and then adjust it in recent years based on what they learn in partial acquisition first (Xingliang and Guanming, 2011).

Section 2.1.2. Empirical analysis of literature

New agricultural innovation is the formation of a new concept or practice that is accepted as new by the individual (Toborn, 2011). As agricultural technologies are introduced in packages, the adoption of new technologies in the context of agricultural products from advanced germplasm (high value varieties), the use of modern machinery or farming equipment, resource management such as soil and water management techniques, weeds and pest management techniques, integrated farming techniques, conservation practices .

2.1.2.1. Induced innovation

A variety of innovations should be used to address the local diversity of agricultural production. The diversity of agriculture and its exposure to random events such as climate change and pest infestation led to the creation of a network of research stations. A major field of agricultural research aims to develop innovative practices that develop practices and varieties that are relevant to specific environmental and climatic conditions. The emergence of new pests and diseases has led to the development of research and product preservation with the sole aim of developing new ways of responding to adverse effects whenever they occur.

New production models similar to those of Binswanger's (1974) are useful when design links to costs, prices, and technologies are linked. However, some important details are overlooked that set out the process leading to agricultural innovation. Often, new agricultural technologies are not used by developing businesses (e.g., universities and equipment manufacturers). Different types of businesses have their own different decision-making processes that need to be seen in a more detailed analysis of agricultural innovation.

2.1.2.2. Political Economy of Publicly Funded Innovations

R&D efforts are supported by both the public and private sectors as a result of the exciting repetition results of innovation. Public R&D efforts are guaranteed by the positive public environment of these activities and the failure of private companies to reap all the benefits of farm design. The study found a high return (more than 20 percent) on public investment in agricultural research and extension, indicating a lack of investment in these activities [see Alston, Norton, and Pardey (1995)]. Analysis of public spending R&D patterns in agriculture shows that public finances tend to focus on scientific research and products grown in several provinces (e.g. wheat, maize, rice), while individual countries provide the majority of public support for innovation - special government attraction activities (e.g. ., tomatoes and oranges in Florida, and fruits and vegetables in California).

The devolution process has also been applied to public research and, over the years, the government's share in public research has declined with regard to the state budget. The growing concern of environmental issues and resource management over time has led to an increase in the equal share of public research resources allocated to these problems in agriculture [Huffman and Just (1994)]. Many studies examining a return to community-based agricultural research (including the 1957 Griliches study on hybrid-bearing hybrid corn) rely on a more consistent analysis. In cases, we have public investment such as IITA or IRAD, where many varieties of cassava are made at a time that can withstand pests and diseases and increase emissions.

2.1.2.3. Policies and Institutions for Managing Innovation Activities

The concept of innovation emphasizes the role of global economic conditions in creating a direction for new jobs. However, innovation also requires specific policies and institutions that provide resources to potential developers and enable them to reap the benefits of their new programs. Copyright protection is perhaps the most obvious incentive for new jobs. Recipients of new patented technology have the right to use the property for a specified period of time (17 years in the U.S.).

Another tool could be the reward for the discovery of new technologies, examples abound where governments have used prices to create creative solutions to complex technical problems. The agreement, which rewards inventors for their efforts, is a way to encourage new jobs. Public / private sector co-operation is important.

2.1.2.4. Adoption and Diffusion of Agricultural Innovation

There is always a big gap between the time when something new is made and made available in the market, and the time that most producers use. Adoption and distribution are processes that control the use of new materials. Behavioral behaviors emphasize factors that affect when a person will start using them. Acquisition measures can indicate both the time and extent of the use of new technology by humans. Acquisition behavior can be expressed in a single variation. It can be displayed with a different option, whether to use a new item or not, or with a continuous variable that shows how much new a feature has been used. For example, one measure of the acceptance of high-yield seed varieties by the farmer is a different variation which indicates that this variety is used by the farmer over a period of time; another estimate is the percentage of the farmer's land grown on this type.

While it helps to use the word "acceptance" to denote one's behavior towards something new and "spread" to denote integrated behavior, in the case of fragmented technology, some economists tend to distinguish between internal and intensive spreads. For example, this distinction is especially useful in the operation of many plants or fields. Intra-firm studies can investigate the percentage of farmer's land where drip irrigation is used, while integrated distribution studies will look at the percentage of land donated to cotton irrigated by drip practice. The adoption of cassava varieties developed through agricultural technology provides an opportunity for increased productivity and higher incomes (Nweke and Akorhe, 2002) and has led to the collapse of food insecurity (Nata et al., 2014).

2.1.2.5. Geographic Considerations on Agricultural innovation

Most of the new social science literature emphasizes the role of distance and geography in the adoption of technology [Rogers (1962)]. It is clear that Manufacturers who are far away from the regional center may use the technology later. This pattern is consistent with the findings of restraint models because early learning and the introduction of new technologies may incur significant travel and transportation costs, and these costs increase over time. Most of the areas located in the area around the research centers are therefore clearly and more likely to benefit from improved cassava titles compared to those in the hinterlands area.

Diamond’s (1999) book on the emergence of human societies emphasizes the role of geography in the adoption of agricultural technology. Geography sets two barriers to acceptance: climatic diversity (producing different species to suit different natural environments) and distance. Investing in infrastructure to reduce travel costs is likely to accelerate adoption.

One reason for the increase in technology in the United States is the emergence of national media and a significant reduction in access costs that has led to the establishment of railways, a highway system and rural electrification. The distance is a major obstacle to the adoption of technology in developing countries. Distance barrier is likely to be reduced by the proliferation of wireless communication technology. It is a great challenge to embrace technology in all different latitudes and different natural conditions. The establishment of international research institutes that develop production systems and plants for specific conditions is one way to overcome this problem.

Section 2.2 Global efforts on research and development in Cassava

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Cassava (Manihot esculenta Crantz) is a staple food for more than 500 million farmers and countless processors and retailers worldwide (Plucknett et al. 2000). This plant is very strong, drought tolerant and cassava production does not require high inputs. Cassava originated in South America where it lived for 2,000,000,000 BC. and introduced to Africa in the 16th century by the Portuguese (Fauquet and Fargette, 1990). In the 18th century it was introduced along the east coast of Africa and in the Indian Ocean Islands of Zanzibar, Madagascar, and Reunion.

Global cassava production in 2002 was 184,852,540 metric (t), with 100,689,149t being produced in Africa alone, according to FAO in 2003. Africa claims 11.9 million ha (FAO, 1997a). In addition, it is estimated that the introduction of more productive varieties, improved pesticides and disease control and better processing methods could increase cassava production in Africa by 150% by 2015 (FAO, 2000).

Section 2.2.1 Research and Development in Cassava

Agriculture has many opportunities for industry to contribute to economic growth and development. Changes in agricultural technology require the constant flow of new technologies for farmers and a variety of options. This document raises two questions: Can cassava, traditional food crops, be the basis for the raw material of many used products and industrial development that will effectively increase the demand for cassava and thus contribute to agricultural and economic transformation in developing countries? If so how?

The above questions answer a four-year effort by the International Fund for Agricultural Development: (1) to determine the quality of the cassava industry worldwide; (2) understand the potential and limitations of cassava such as food and industrial plants; and (3) establish programs to ensure that cassava can and will play a significant role in the development and economic growth of developing countries, especially in rural areas.

Thailand provides a striking example of the contributions of the growing cassava sector to economic growth and the well-being of those associated with the industry. A country with no history of cassava production as a basic human food, Thailand in a few short years in the 1960s and 1970s developed a powerful cassava exporting company that supplied a cassava-based animal supplier to the European Community. What is needed is a global concept of cassava that can be translated into the plans and actions of nations, regions and continents.

Traditionally, cassava is widely grown by small families in a small independent country. The roots are processed and processed as food crops for home use and sold in rural markets and some are exported to urban areas. Over the past 30 to 50 years, smallholder farmers in Ghana and Nigeria have grown cassava production as a cash crop, especially in urban markets. This shift from cassava production mainly for domestic use to urban consumer trade, livestock feed and industrial use can be described as cassava conversion.

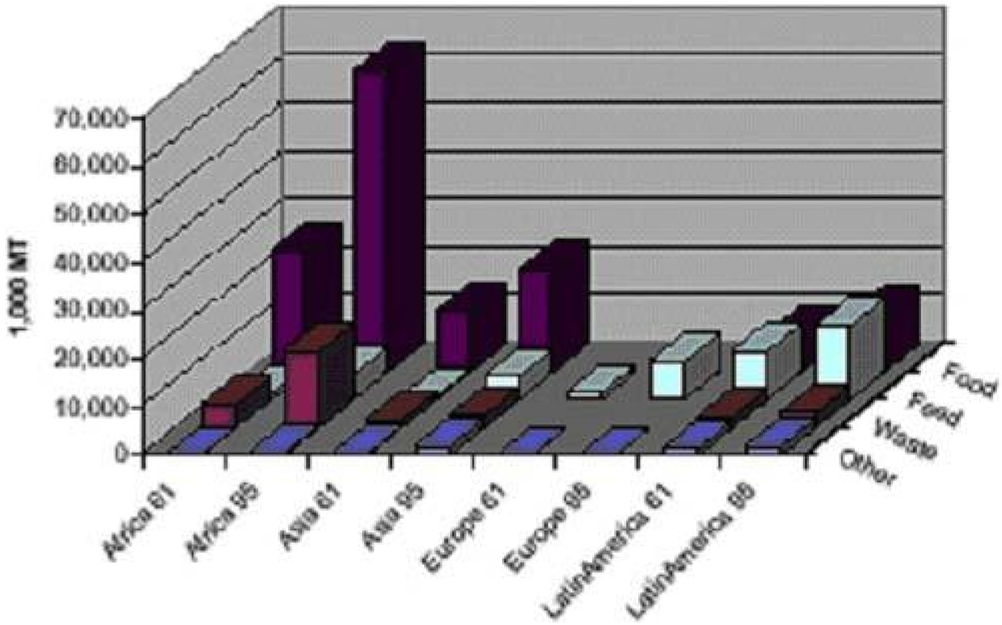
During the conversion of cassava, high yielding cassava varieties increase yields while labor-saving methods and improved processing technologies reduce the cost of producing and processing cassava food products to the point of competing with food grains such as wheat, sorghum and rice for urban consumers. Looking ahead, as the costs of cassava production, harvesting, processing and marketing are reduced, one would expect the cassava to play an expanded role as a source of industrial raw materials in Africa and as a source of revenue for the export of livestock feed.

Cassava can do well in areas where other grains and plants will not survive or be done properly. It can withstand drought and can be grown in low nutrient soils, but responds well to irrigation or high rainfall conditions, and to applying fertilizer. Cassava is highly adaptable to its management needs, and has the potential to generate high power in each part of the world. When it is considered pest and disease, the crop can be genetically enhanced to increase its resistance to pests and serious diseases. Cassava fruits can be very high, up to 25 to 40 t / ha, although national yields are often much lower than these levels. Land average is estimated at 10 t / ha.

The crop has long been used as a food reserve and food security crop. Because cassava does not have a place for direct ripening, yields may be delayed until market, processing or other conditions are favorable; this flexibility means that the cassava can be kept in the field for a few months or more. Although it has long been considered a smallholder crop, cassava can be grown on large plantations or in favorable conditions for industrial production. Cassava starch has certain distinctive features that prefer its use in special market pits. In general, cassava has the potential to enter various markets.

Cassava use at regional level has emerged since 1961 as can be seen in Figure 1. During the nearly 35 years as shown in Figure 1, food cassava doubled in Africa and increased by 70 and 50% in Asia and Latin America, respectively. . Another area of growth has been its use as animal feed, and the largest increases have been in Europe, Latin America and Asia. What seems to worry is the high levels of persistent cassava waste seen in Africa, Asia and Latin America. Latin American waste exceeds the amount of cassava used for food consumption. Another interesting observation is the growth of other uses in Asia, and not shown in this figure is the growth of North America in other uses, which in 1995 surpassed that of Europe. Other uses include the use of cassava in the production of starch, adhesives and alcohol.

Figure 1: Consumption of cassava by regions, 1961 and 1995(tons)



Source: (FAO, 1999)

Hidden in Figure 1 is the fact that in 1961, with the exception of other Latin American countries, more than 80% of the violence was consumed in the productive country. Apart from the cassava-producing countries, cassava was popularly known as tapioca. With the advent of the European Economic Community and its general agricultural policy the cassava became a commodity that first entered the European food market. The advantage of cassava was that it was a free energy source that could be mixed with soybeans and other high protein foods. In the 1960's and early 1970's, European traders encouraged more cassava-producing countries to produce for the European Economic Community. From the beginning of 1961, Thailand was the leading exporter of cassava in Europe. In 1972 Thailand was the main source of increased land supply, while Indonesia remained second only in the distance (Phillips, 1974).

Table 2.2 Regional cassava imports (tons)

Region	**1961**	**1970**	**1980**	**1990**	**1995**
Africa	75	1845	3975	10760	18926
Asia	50334	257283	428877	4891944	2574110
Europe	1493616	4467809	16499999	26 012 876	8 651 648
Latin America	4 902	6106	4811	199 188	63 547
North America	496 900	376 143	106 140	680 098	193 157
Oceania	15	252	1104	36580	48351
Former Soviet Union	-	-	-	2 815 154	-
Total	2045842	5109438	17044906	34646600	11549739

Source: (FAO, 1999)

As of 1961 only seven countries (five of which were European Union countries and Japan and the United States) were importing more than 10,000 tons of cassava. In 1990, the number of countries increased to more than 26 countries importing more than 10,000 tons. Thus, there has been both an increase in demand for cassava and a diverse increase in its markets. At the same time, the number of exports increased from 8 to 14. In 1990 Thailand accounted for about 76 percent of total exports. Cassava was introduced to Africa by Portuguese traders from Brazil in the 16th century (Okigbo, 1980). Initially it was accepted as a famine crop.

In the Democratic Republic of Congo (later called "Congo") where the plant was first introduced, sorghum, bananas, and yams were a staple food, but farmers took the cassava because it provided a reliable source of food during drought, locust infestations, and famine. Although there was some trade in cassava, the product was mainly made for home use and cassava was prepared in a simple way, meaning cutting and boiling. Currently, about half the African cassava product is in Africa. Cassava is grown in around 40 African countries, stretching along the broad belt from Madagascar in the Southeast to Senegal and Cape Verde in the North West. About 70% of African cassava production is harvested in Nigeria, Congo and Tanzania (IFAD and FAO, 2000). In all of Africa's forests and changing landscapes, cassava is a staple food or food staple.

Cassava has ways to increase income on farms, reduce rural and urban poverty and help close the food gap. Without a doubt, cassava has high hopes of feeding the growing population in Africa. Cassava can be produced by family work, land and plow and machete, making it an attractive and low-risk crop for poor farmers. Also, cassava is available in low-income households with simple food products (for example, dried roots and leaves) that are much cheaper than grains such as rice, corn and wheat. Similarly, urban homes in many parts of West Africa consume cassava in the form of gas.

However, researchers have neglected the study of cassava for a variety of reasons, with African policy makers and many donors and international organizations. Cassava is a plant that has been marginalized in food policy negotiations and has been plagued by the shame of being low, unpretentious and not competitive with luxury crops such as imported rice and wheat due to several long-standing myths and unfounded facts. Many food policy analysts view cassava as a low-income food because it is thought that its consumption per capita will decrease with increasing individual income.

Details about cassava in Africa were still scarce for the dead. In 1989 however, the Collaborative Study of Cassava in Africa (COSCA) was launched by the Rockefeller Foundation and based in IITA. Over a period of eight years (1989 to 1997), COSCA researchers collected data on 1686 households in 281 villages in six countries: Congo, Côte d'lvoire, Ghana, Nigeria, Tanzania and Uganda. The purpose of the Global Cassava Development Strategy (GCDS) is to analyze cassava production and the methods used; identifying challenges and opportunities in the cassava sector with an emphasis on poverty alleviation, equity, food security and environmental protection; and developed a set of priorities for future interventions in the cassava sector (Spencer and Associates, 1997).

This review is based on information from six COSCA study countries comprising secondary data from FAO and a variety of information collected from African farmers, researchers, traders and processors across Africa from the beginning of the COSCA study from 1989 to 2001. This review shows that the planting of new Tropical Manioc Selection (TMS) cassava varieties developed and exported to farmers in Nigeria in the 1970s by IITA, has transformed cassava from a low-yield crop to a high-yield crop. Reviews show that with the help of car grater grills, cassava is increasingly being produced and processed as a cash crop to be used in cities in Ghana and Nigeria. The next stage in the cassava transformation is from the food crop to the raw material for livestock and industry for the income of the farm.

International research on cassava development was launched in the early 1970's at the International Institute of Tropical Agriculture (IITA) and the International Center for Tropical Agriculture (CIAT) with a focus on developing highly productive varieties that are resistant to pests and major diseases. In addition to producing high yields and resistant to major pests and diseases, cassava research involves improving biological control and integrated pest management options to reduce losses due to pests. In the SSA, this work has led to several species of eliteypes that opposed cassava mosaic (CMD) and cassava bacterial blight (CBB) as well as high and stable fruits and good consumer acceptance. The development of improved varieties and their introduction to national testing systems under certain local conditions in the late 1970s and 1980s led to the successful introduction of high-yielding and disease-resistant varieties to be accepted by farmers.

New varieties include improved CMD tolerance and popular post-harvest features, extensive agro ecological variability, and 50 ± 100% high yields even without the use of fertilizers (A Parmar, B Sturm, O Hensel - Security, 2017 - Springer). Despite the great success of research in the past, the yield of cassava farms remains low especially in Africa due to the many emerging threats such as pests and diseases. Recognizing the potential high yields in the agricultural sector requires ongoing investment in genetic development and better agronomy and pest and disease management. To help combat the threat of pests and diseases, scientists should identify and use biotechnology tools to improve genetic markers such as whitefly resistance, quantitative trait loci (QTLs) in people from heterozygous parenting genes, and rapid disease recurrence mechanisms- free plant material of tissues.

It is well known that increasing agricultural productivity at the levels required to feed the growing world population requires more public investment in research and development and widespread dissemination of new technologies, but funding for national and international research has declined over the years. In this context, prioritization has become increasingly important in allocating scarce research resources among competing needs to achieve significant impacts. Significant systematic assessments have been conducted since recently by consolidating scientific views on the ability to address specific issues through research and technology options and economic evaluation of potential benefits through the adoption of such technologies (1995 - Taylor & Francis). Following its official launch in 2012, the CGIAR Research Program on Roots, Tubers and Bananas (RTB) began exploring strategies for prioritizing research on bananas, cassava, potatoes, sweet potatoes and yams.

2.2.1.2. Sector analysis

The global cassava development strategy requires an "industrial analysis". Industry analysis involves participants in participatory efforts to identify strengths and weaknesses in all stages of the production / integration / marketing of cassava and to find ways to strengthen the system and overcome its weaknesses. Industrial analysis is a process driven by the need for technological change through: (a) a clear view of stakeholders as equitable partners in determining the needs and future plans of the dynamic cassava industry; (b) develop an effective, shared vision for cassava development; (c) assisting in the formulation of sector action plans, including who, what, why, how, and the question, and whose funds; (d) build better linkages with private sector organizations; (e) to facilitate better communication between and between public institutions; (f) co-operation in research management and service results with users; (g) the rapid introduction of technologies that have a significant impact on public-private partnerships.

Market opportunity analysis suggests that sector analysis should focus on a range of targeted products that are available or that appear to have potential growth potential. Industry analysis should indicate which of these products will require special attention in the production-processing-sales system.

The above goals and objectives are associated with a number of outcomes such as: (1) increased access to, access and use of beneficial technology; (2) strengthen the capacity of the people and institutions of agricultural and farm systems and markets; (3) favorable policy and market areas for the potentially powerful cassava industry; (4) the increase in the availability of a wide range of high quality products at reasonable prices to consumers and the good profit from manufacturers; (5) increase local and international political and financial support for the development of the cassava industry.

Cassava is seen as a product of the future because of its value and quantity of products, including food, flour, animal feed, alcohol, starch and paper size, flavors, processed foods and perishable products. These products are found in many varieties of cassava, from fresh leaves and roots to modified cassava starch. The level of processing and technical requirements often rises from a new form to a modified starch form.

All of the above products represent opportunities to develop the cassava market. While some cassava is marketed as fresh roots or leaves, even these products usually receive post-harvest treatment or treatment before they are eaten. Since cassava usually needs some form of preparation before it can be eaten or sold, processing becomes an important factor in the future of the plant. While market opportunities are great, it should be borne in mind that these opportunities are specific to time and space. Due to the specifics of market opportunities, it is not possible to list key market opportunities.

2.2.1.3. Genetic development of cassava

The improvement in cassava continued over the years has been encouraged by small African owners and government and private institutions. IITA for example developed high-quality brands that are resistant to colorful paintings within six years (1971 to 1977) of research. These most productive types that include color suspension include TMS 50395, 63397, 30555, 4 (2) 1425 and 30572 (referred to here as TMS types). Newer TMS varieties have been shown to be significantly higher than local varieties on farmers' farms by 40 percent without fertilizer. A COSCA study in Nigeria found that TMS varieties are superior to local varieties in terms of production, attention and pest and disease tolerance and are similar to local varieties in terms of post-harvest and crop planting characteristics. The emergence of cassava breeding in Africa can be described as a human ladder.

Section 2.3 Emergence of Cassava Research and Development in Cameroon

Cassava was easily adopted by farmers and incorporated into traditional agricultural and food systems in Africa due to its low resource requirements and equal freedom of cultivation and processing (Hahn et al., 1979). In Cameroon, cassava is widely grown as an intercrops and maize in general without the use of fertilizer for almost all production by smallholder farmers. This goes hand in hand with the destruction of the year and the devastating effects of the rapid decline in crop yields. However, cassava in pristine areas can be found in the southern parts of the country even though it is grown in almost all agricultural areas due to its ability to thrive in rainfall areas between 508 and 1524 mm and annual temperatures between 17 and 30 ° C. particularly in the fight against hunger through continuous food supply when other crops fail.

There are major difficulties that need to be addressed urgently and widely from plant performance, agronomic, edaphic and social and economic issues, technological development and transfer (Dahniya, 1994). In a study of the Ecologically Sustainable Cassava Plant Protection Project (ESCaPP) reported by Okeleye et al. (2001), other production parameters such as land preparation methods, weed management, crop size cut and crop varieties that have a product impact.

The interest in research and development at Cassava in Cameroon came from the international tropical agricultural center at the University of Ibadan in Nigeria. Breeding of major diseases began at IITA in 1971 (Hahn, 1980) and gradually progress has been made in creating a number of plant-resistant species. IITA-Ibadan has developed a cassava distribution program since the early 80s where it introduced disease-resistant cassava compounds to increase cassava production, and launched a development research project called the Integrated Cassava Project (ICP) to fund a presidential cassava program launched in 2002 in Nigeria (Nigeria). Abdoulaye et al., 2014).

In line with such a vision of the R4D, IITA Cameroon thus introduced the highly developed IITA-resistant strains of pest / disease-resistant strains tested at the Ibadan station, to further test their potential in the full range of potential end users in Cameroon. Cassava's exploration and distribution program in Cameroon is made up of integrated communications activities involving partners including a national organization such as PNDRT (National Root and Tuber Development Program), IRAD (Center for Agricultural Research and Development), Local and International Non-Governmental Organizations (NGOs). NGO), Community Based Organizations (CBOs), Farmers Association etc. Their main activities are:

- ✓ Trials Cassava testing at IITA Mbalmayo station at the station which started in 2001 and ended in 2004, following the IITA breeding program, in which eleven top clones were selected based on farmers' preferences.
- ✓ Trials Involved on-farm cassava trials conducted in 2004 and 2005 sowing times and regional inspections in 2006 using a harp / antenna in Ebolowa, Bertoua, Bamenda, Kumba and Ngaoundere representing five parts of Cameroon's agricultural environment.
- ✓ Participation Active participation of farmers in the testing and selection of preferential varieties and their distribution and distribution.
- ✓ Survey Research and testing of all distributed particles in the response of pests / diseases.
- ✓ Manufacture of simple cassava repair machine and delivery in partnership with independent manufacturers and PNDRT networks.
- ✓ Establishing forums for stakeholders, partners and investors to increase the profitability of the cassava price chain from producers to consumers.
- ✓ Cassava and its role in fighting poverty and providing income as a source of starch and fodder for livestock.

To meet the demand for domestic food in Cameroon, cassava is given priority because cassava is prioritized between root crops and root crops in terms of total production and consumption and is a powerful crop to increase farm income, reduce rural and urban poverty. More than 204,548 hectares of arable land in Cameroon were donated to cassava production by an increase from 2.3 million tons in 2005 (PNDRT, 2005) to 5 million tons in 2010 (Agristat, 2010). Cassava is grown mainly for its starchy roots, which are eaten raw, boiled or processed but also for its leaves that act as vegetables during pruning cassava for planting. Cassava roots are processed in a variety of ways into many products and used in a variety of ways depending on local culture and preferences (Nweke, 2004).

In some regions, the leaves are eaten as a vegetable, and most traditional foods are processed from cassava roots and leaves (Njukwe, 2014). While the roots are actually carbohydrates, cassava leaves are a good source of protein and vitamins that can provide an important addition to a starchy diet in particular. Cassava leaves are rich in protein, calcium, iron, and vitamins, compared with other raw vegetables such as amaranth and spinach, which are often considered good sources of protein (Nagib and Antonio, 2006). Cassava leaves form an important part of the diet of people in the southern, central and eastern regions. It is used as one of the preferred vegetables in many cassava growing areas and is widely offered as an edible sauce with fufu and boiled cassava. The public agricultural research organization is the Institute of Agricultural Research for Development (IRAD), which was established in 1996 to conduct agricultural research with a mandate to focus on annual and perennial crops, livestock and fisheries, forest and environment, farming systems, economics and rural sociology. IRAD works in collaboration with many local and international research institutions and development partners. Some government and private universities are also involved in agricultural research in Cameroon. These include: University of Dschang, University of Ngaoundere, University of Yaoundé I, University of Buea, University of Bamenda, Catholic University of Cameroon.

Cultivation and development of cassava in Cameroon has also been through the installation of new platforms. According to FARA, the renaming platform is a physical or practical platform established to facilitate communication and learning among selected participants in a series of assets, leading to a participatory approach to problem solving, collaborative exploration and solution research. The purpose of the new platforms is to promote agricultural innovation in the target list.

Innovation in agriculture is the process of ensuring that a new product or knowledge is transformed into a sustainable use. One of the most important and emerging ways to implement new agricultural development programs through the Integrated Agricultural Development concept developed by the African Agricultural Research Forum (FARA). Innovative platforms are widely used in agricultural research projects in Cameroon.

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In Cameroon, we have the following cassava platforms; Center, East, South & Littoral Regions (NkongAbok, Batchenga, Okola, Ngat, Gouekong, Lobo, Banyo, Mefomo, Kiki, Pouma and their major activities there; Distribution of New Agricultural Technology in Africa (DONATA) (2007 to 2014)) Funded by the African Development Bank through FARA and operated by IRAD.Focus on Cameroon was on production, use and marketing.

Cassava is grown in more than 100 countries around the world. It holds the position of strategic plants in many tropical countries. 229,540,896 million tons of roots are produced worldwide. In Cameroon, it is the leading crop in terms of annual yields for cash and food crops. It is more widely used and processed than maize and rice Since the 2000s, investors have become increasingly aware of the potential of this sector; however, its full potential has not yet been achieved. The high demand for new roots and found products is met with little, in the African region where Cameroon participates in the bread basket, providing more than 70% of the food crop market. Strategic planning is very much needed.

Strategic planning involves the development of long-term strategies to increase the profitability and competitiveness of the cassava sector from the farm level to the end of the consumer. This means developing new and sustainable projects such as on-farm processing, appropriate marketing mix and effective production. The purpose of strategic planning is to design a set of tasks that allow intervening actors to achieve their and national goals. The strength of the cassava sector can be used to exploit opportunities in the national economic bond of jobs. The table below provides a comprehensive overview of the cassava cultivation in Cameroon between 2002 and 2013.

Table 2.3 Statistical overview of cassava cultivation in Cameroon between 2002 and 2013

Year	**Cassava production in tons**	**Year**	**Cassava production in tons**
2002	2003635	**2008**	2882734
2003	2047712	**2009**	3340562
2004	2092764	**2010**	3808239
2005	2393801	**2011**	4082902
2006	2652176	**2012**	4287177
2007	2767455	**2013**	4596383

Source: National institute of statistics, Annual statistics of Cameroon, 2015 Edition

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CHAPTER THREE

METHODOLOGICAL FRAMEWORK

Section 3.1 Presentation of Area of Study: Manyu Division

3.1.1. Presentation of Manyu Division

MANYU division is one of the divisions that make up the six divisions of the south west region in Cameroon. It has four sub divisions which include: EYUMOJOCK sub division, MAMFE sub division, AKWAYA Sub division and UPPER BAYANG sub division. It is bordered by the Federal Republic of Nigeria in the West, The North West region in the North, Ndian division in the south and in the west by KUPE MANENGUBA. This division is situated in the Equatorial rainforest from two to sixth degree North and characterized by heavy rainfall of about 2000mm. The average temperature is at about 25^{o} Celsius. Thus, the climatic conditions are much favourable in the cultivation of both staple and cash crops.

Manyu division just like any other division in Cameroon is mostly characterized by a rural population with Mamfe town which is the biggest town and capital of Manyu division serving as the only semi-urban setting. The main economic activities are centered on agriculture and trading. They produce some food crops such as maize, plantains, cassava, Cocoyam, Yams, Bananas, vegetables, etc. The main cash crops produced by indigenes of this division include; Cocoa and Oil palm which serve as the greatest source of income to the locals.

The division has a road transportation network linking the federal republic of Nigeria, the Northwest region and the rest of south west regions following the tarring of Bamenda-Mamfe-Ekok stretch of road and Mamfe Kumba road respectively (see Map below). This improvement in transportation network has brought about increase in trading activities especially for agricultural products with the greatest demand coming from neighboring Nigeria which is the most populated Nation in Africa. Research and development activities in the agricultural domain in recent times in Manyu division have faced numerous challenges due to distance from the focal points of research institutions mostly based in Yaoundé. Many actors in the agricultural sector are engaged in the cash crop sector neglecting the food crop sector despite the numerous opportunities and necessity of food crops.

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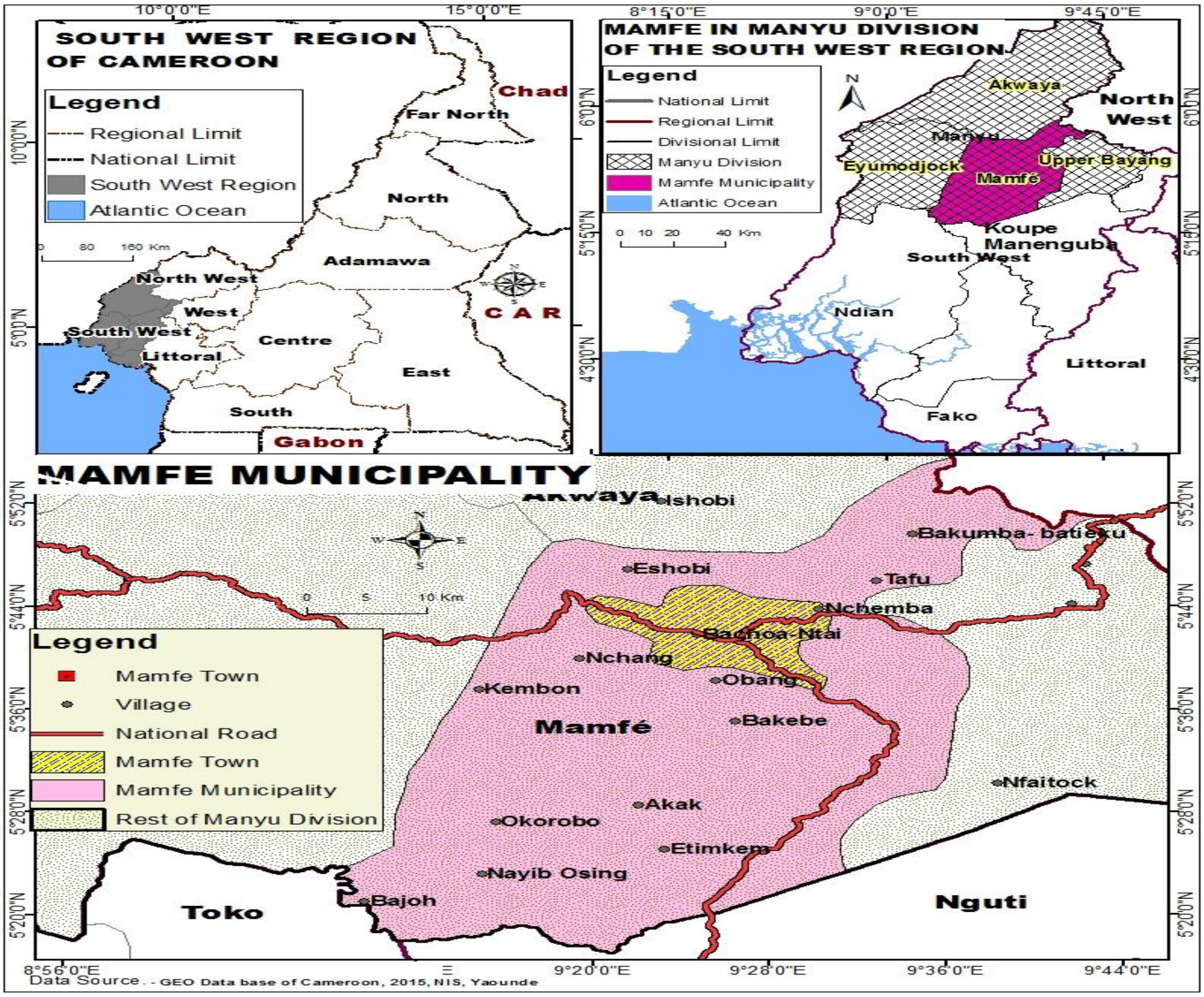
Figure 2: Map of transportation network in Manyu



Source: Geography of Cameroon

The main activity practiced in this region is Agriculture dominated by the cultivation of both cash and food crops. The division is mostly characterized by rural settings. Over 80% of the population leaves in rural dwellings with the only major town being Mamfe town which host government and private institutions and is the capital of Manyu division.

3.1.2. Presentation of Agricultural Innovation in the Cassava sector

IRAD so far has developed over 200 new varieties of cassava. There are numerous choices for cassava farmers when it comes to the selection of choices. In 2015, the Institute for Agricultural and Research Development (IRAD) announced that it has developed to date over 200 local varieties. Of these varieties, six (6) where improved. In addition, these new varieties where developed to adapt to all the various Cameroon ecological zones, the results of the improved varieties where quite satisfying. These varieties on an acre can produce up to 25-40 tons of cassava, against 12 tons for traditional seeds, IRAD says.

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IRAD's interest in investment in cassava lies in the fact that it is one of the most consumed in Cameroon since it can be processed into many forms. Moreover, cassava is very popular among agro-businesses. However, the national production for cassava remains low and barely meets the populations and businesses' needs. To overcome this, the government and World Bank launched PIDMA, a 50 billion FCFA-project aiming to boost not only cassava production but also that of sorghum and maize. While conventional cassava varieties can produce 9-10 tons per hectare, these varieties are improved, according to Rachid Hanna, who represents the country with the International Institute of Tropical Agriculture (IITA) and PNDRT which can produce 19-25 tons per hectare.

The cassava crop is considered to be the key to improving food satisfaction during climate change. Common varieties are considered by Cameroonians to be the "last" crop as they can grow in poor soil and harsh climates, and require little fertilizer. About 80 percent of Cameroonian households, most of whom are subsistence farmers, eat cassava daily, although a 2010 study by Plant Foods for Human Nutrition showed that cassava consumption is a risk factor for vitamin A, zinc and / or iron deficiency.

Despite all of this, limited research on cassava varieties has so far taken place in Africa as IITA is doing its best to change that view. After introducing new varieties throughout the hot cassava belt, productivity in cassava throughout the national territory has not been uniformed based on statistical information gathered as can be seen on table 3.1 below. There is variation in output per regions owing to various factors ranging from climatic conditions which favor the cultivation of cassava especially in the equatorial rainforest areas spreading across the south west, south, center and east regions.

Table 3.1 Area and production of Cassava per region 2009 to 2011

Product	Cassava			
		2009	2010	2011
Adamawa	Area	9741	11274	11421
	Production	141899	165171	175432
Center	Area	80676	86819	92896
	Production	1057714	1198080	1346642
East	Area	67726	11274	64651
	Production	739943	165171	823174
Far North	Area	500	474	488
	Production	4788	5257	5899
Littoral	Area	10106	13928	14151
	Production	283926	311123	329691
North	Area	2355	3516	3558
	Production	25724	29642	34207
North West	Area	10758	13768	14264
	Production	100751	110708	130746
West	Area	6500	15100	14647
	Production	110496	121634	128932
South	Area	33547	35467	37205
	Production	549779	630573	650829
South West	Area	19864	26303	26908
	Production	325542	430694	457350
Cameroon	Area	239418	270787	280189
	Production	3340562	3808239	4082903

Source: National institute of Statistics. Annual statistics of Cameroon, 2015 edition

The table above depicts variation in cassava production owing to variation in Natural conditions such as climate and soil types. The Southern part of Cameroon which are mostly characterized by heavy rainfall and thick equatorial rainforest have more favorable conditions for the cultivation of cassava than the Northern parts of the country with desert soils and low rainfall. The Center region tops the chart between 2009 and 2011. This area is located within the equatorial rainforest and mostly surrounded by research institutions such as IITA, IRAD etc. As such productivity is bound to increase as farmers are exposed to numerous varieties of improved cassava species and other agricultural products as in table 3.2 below. The center region can easily benefit from improvement in the value chain of agricultural products more than any other region.

Table 3.2 Evolution of the production of principal agricultural products in Cameroon 2002 to 2013

Products/ Years	Rice	Maize	Sorghum	Potatoes
2002	44545	861392	1073663	136342
2003	47177	912223	1097282	139342
2004	49960	966040	1121426	142406
2005	58369	1050396	1352693	133811
2006	64525	1249489	1375386	142119
2007	68267	68267	1428568	143568
2008	72013	1394832	1481750	145019
2009	144659	1625213	1537057	166772
2010	163078	1670321	1632004	188452
2011	174089	1572067	1568804	196687
2012	181818	1749976	1425895	210015
2013	194094	1647036	1490060	219192

Source: National Institute of Statistics. Annual statistics of Cameroon, 2015 edition

The south west region (Manyu division) with similar characteristics as the center region is still lacking behind as per the statistics within this period of 2009 and 2011 (table 3.1). This therefore brings in the preoccupation of our studies which centers on research and development on Agricultural Productivity, obviously, taking it to the hinterlands like Manyu Division which offers numerous opportunities for growth. A total of 2.5 million tons of cassava are produced in Cameroon every year. Most are turned into flour; the rest is added to alcohol, animal feed, and further processed into biofuel (ethanol).With the above analysis and need, the focus of this research will evidently look at the following areas of research and development in improving the cassava sector.

3.1.4 Data used in this study

Data sources are gotten from both primary and secondary sources. Primary sources of information involved field observation, interviews and questionnaires. From this premise, the techniques employed were; Structured Questionnaires were administered in some selected rural communities in Mamfe and Eyumojock sub divisions as is observed on the table below (table 3.3). In all, a total of six (6) villages where selected from Mamfe Central sub division and included; Bachou Ntai, Bachou Akagbe, BessongAbang, Nchang, Eyanchang and Etemeteck. Meanwhile in Eyumojock sub division a total of thirteen (13) villages where selected and included; Mbakem, Tabo, Ayukaba, Afab, Ogomoko, Mbakang, Ewelle 1 and Ewelle 2, Mfuni, Bakwelle, Mkpot, Mbatop and Ebam.

Target individuals were farmers who are actively involved in agricultural activities and specifically cassava cultivation. Thirty (30) questionnaires each where administered to farmers of Bachou Ntai, Bachou Akagbe, Bessongabang, Nchang and Eyanchang while ten (10) questionnaires where administered to farmers in Etemetek because of the small nature of the community. At Eyumojock sub division, the village of Afab had 20 questionnaires, Mbakem, Mfuni, Tabo, Ayukaba, Bakwelle, Mkpot, Ewelle 1 and 2, Ebam, Ogomoko, Mbatop, and Mbakang all had 10 questionnaires each. All were given back in Nine (9) days. The advantage with questionnaire is that it is cheaper, quicker and more convenient to administer.

Table 3.3 Distribution of questionnaires table

Name of village	Nº of Questionnaires	Sub Division
Bachou Ntai	30	Mamfe Central
Bachou Akagbe	30	Mamfe Central
Besongabang	30	Mamfe Central
Nchang	30	Mamfe Central
Eyanchang	30	Mamfe Central
Etemeteck	10	Mamfe Central
Ebam	10	Eyumojock
Afab	20	Eyumojock
Mfuni	10	Eyumojock
Mkpot	10	Eyumojock
Bakwelle	10	Eyumojock
Mbatop	10	Eyumojock
Mbakang	10	Eyumojock
Mbakem	10	Eyumojock
Ewelle I	10	Eyumojock
Ewelle II	10	Eyumojock
Ayukaba	10	Eyumojock
Ogomoko	10	Eyumojock
Tabo	10	Eyumojock

Source: Field work 2019

Primary information was also gotten from the divisional delegation of agriculture, divisional delegation of scientific research and innovation and farmers associations. The exercise assemble important data factors which included the characteristics of the household and composition, cassava varieties and total area planted, membership of different rural institutions, production cost, access to information, access to credit and knowledge of cassava varieties.

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Section 3.2 Model choice, analytical Framework and sampling procedure

Section 3.2.1 Modeling and Analytical Framework

In all, a total of 199 interviewed were involved in the cultivation of cassava, making it 67% against 101 who were not involved in the cultivation, i.e. though they may reap from the benefits of cassava either because they live with a cassava cultivating individual or consume it through purchase, putting the percentage at 33%. The main questions focused on the farm size: where in all those involved in the cultivation of cassava had farmlands less than one hectare allocated for the cultivation of cassava. The reason for this small farm sizes was not because of inaccessibility to land ownership, but was mainly based on the fact that most farmers prefer to allocate a greater part of their farmlands to cash crop production.

The subsequent outcome was 0=less than a hectare and 1=more than a hectare. The yields or quantity of output therefore: from 0.55ton on ≤ha= 1, meanwhile from 0ton/ha to 0.5ton/ha=0. Adopters of new varieties (Adopters=1 and non-adopters=0), Gender (Female = 1, male = 0), Age (range 20-40 years were categorized as youths and took value 1 meanwhile 40-and above where categorized as old and took on value 0), Information on availability of new varieties (Access to information=1 and 0 for lack of information, Marital status (Married couples were labeled 1 and single 0), education (Un educated that is those who have not completed primary education=0, completed at least primary and secondary education and can read and write=1) were dummy variables. Other secondary factors included access to credit, training offered to farmers, belonging to a common initiative group, access to fertilizers and other pesticides.

The assumption is that before a farmer decides on whether to adopt or not to adopt any improved variety of cassava, then the farmer has to examine what he/she will benefit from the two conditions. If the gains from adopting the improved variety surpass the benefits from non-adoption, then the farmer will adopt the improved variety and vice versa. Data that we got is will be analyzed using descriptive statistical analysis.

3.2.2 The Procedure of Sampling

A multicenter sampling process was used in this study. The first step was the reasonable choice of two sub divisions of Mamfe Central and Eyumojock in Manyu division .We choose Manyu division from the other divisions producing cassava because of the numerous advantages and opportunities available for the cultivation and production of cassava. Ironically despite these numerous potentials (such as available land, favorable climatic conditions, available man power, an improved transportation network to a large and available market (i.e. Nigeria and available transportation network to the internal market following the tarring of Bamenda Mamfe and Kumba Mamfe stretch of roads), cassava productivity from this area is far lacking behind.

The second reason is purposely because of the non-availability of improved varieties of cassava in this area. The people of this area who between 1998 and 2006 had just one improved variety of cassava (commonly called six months) suddenly as from 2007, started witnessing challenges on the only dependent improved cassava variety, as it was faced with challenges of pest and disease attacks which greatly affected cassava productivity in this area until it was replaced by a new variety introduced in 2014 commonly called "white stem. The selection was also based on the agrarian nature of this Division with more than 90% of the population being rural and of 80% involved in Agriculture as their primary activity.

At the third level, I personally selected the sub divisions of Mamfe and Eyumjock (19 villages in all). These villages where selected because of the seriousness of cassava producers and also because they exhibit similar characteristics with the other sub divisions of Akwaya and upper Bayang. The fourth level was the selection of six (6) districts from the Mamfe Central sub division and thirteen (13) villages from the Eyumojock sub division. The final level was the selection of 19 cassava producing villages from several Manyu Division villages, 160 from the central Mamfe sub division and 140 from the Eyumojock sub division making the total to 300

The number of farmers selected in each community was based on the number of cassava growers. The difference in the number of respondents chosen in these two categories was based on the existing size of the cassava growers in these communities. Of the 300 cassava growers in all samples, data from 300 cassava growers were eventually used for this analysis. Efforts to carry out unstructured interviews with some officials of the divisional delegation of agriculture as well as that of scientific research and innovation, was not possible due to persistent closure of their offices.

Section 3.2.3 Variables uses in the study and data collection

In this study, the farmer was described as a user if he was found to have grown at least one of the cassava varieties introduced at least one season before 2019 (the year in which the data was collected) had varieties on his farms in 2019. Therefore, the farmer can be classified as a clinician and continue to grow certain indigenous species (for example a local variety called panya). The user variant was therefore defined as 1 if the farmer owned the improved cassava varieties and if otherwise zero.

The study used a logistic regression of factors determining farmers' decision to adopt improved cassava varieties. The use of the logit model for this analysis is consistent with the acceptance documents (Alston et al., 1995) describing the acceptance process as taking an ordered form. The difference in response was binary, taking the values one if the farmer is a user and zero if a non-user. However, the independent

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variables were continuous and different. Logit distribution (logit) is more advantageous in the analysis of variable dynamic results because it is extremely flexible and easy to use from a mathematical point of view with logical interpretation (Greene, 2008). It is also used in similar studies by Boaheneet al., (1999); Nkonya et al., (1997); Feder et al. (1985) and Rogers (1995).

Model parameters of the model are uneven and do not work properly. The binary entry model does not make the assumption of solidarity between reliable and independent variables and does not assume the strength of homosexuality. Another advantage of using a logit model is that it does not require variables that are generally distributed and above all, the logit model is easy to calculate and interpret. Therefore, the planning model is selected for this study. The possibilities for a farmer to use at least one improved variety are set out as a function of certain socio-economic factors and the population given in Table 3.4. Following Pindyck and Rubinfeld (1998), a model of accumulation opportunities that is estimated to be economically defined as: $P_i = F(Z_i) = F(\gamma) + \sum_i \lambda_i X_i = \frac{1}{1+e^{-Z_i}}$ (1)

Pi is a visual response to the observation i^{th} as a response to the P variable. It is possible that the farmer may have received at least one type of improved cassava or may have been given Xi; Pi = 1 adopter (i.e. farmers who used at least one improved cassava variety) and Pi = 0 the non-adoptive person (i.e. farmers who do not accept advanced cassava varieties); e means the basis of natural logarithms, approximately 2,718; Xi represents descriptive / independent variables, tailored to each individual, that determine the probability of adoption (P); λ_i and γ are parameters to be considered. Work, F can take the form of regular, systematic or opportunity work. Zi is a Pi-collecting activity (in which case the farmer may find at least one type of improved cassava).

$$1-P_i = \frac{1}{1+e^{Z_i}} \quad (2)$$

The Logit model can be written according to the logs and odd logs, which makes one understand the interpretation of the coefficients. Inconsistent measurements refer to the probability ratio (Pi) used by the farmer, and (1-Pi) the farmer is a non-user . Considering the U_i interference term , the logit model turns to:

$$Z_i = \Upsilon + \sum_{i=1}^{m} \lambda_i X_i + U_i \quad (3)$$

Here, the method followed do not generalized assumptions or homoscedasticity for error predictive variables (Alexopoulos, 2010).

Table 3.4 Description of the variables used in the logit model

Variables (X_i)	**Definition**
Gender	Gender of household actively involved in cassava production, 1 male and 0 female
Marital status	1 if married and 0 if unmarried
Cultivate cassava	1 if main crop is cassava and 0 otherwise
Access to credit	1 if a farmer has access and 0 otherwise
Farm size	Total area of land cultivated by farmers in Hectare
Education	0 for never attempted primary education, 1 for attempted but never completed primary education, 2 for completed primary education and 3 for completing secondary education
Membership of CIG	1 if a member of farmers' CIG and 0 otherwise
information on cassava varieties	1 if a farmer has access to information on high varieties and 0 otherwise
Total income	Proxy for total or net revenue or productivity

Source: Author's field work (2019)

CHAPTER 4

EMPIRICAL RESULTS AND DISCUSSION

Section 4.1 Descriptive statistics of characteristics of the cassava sector

Section 4.1.1 Descriptive analysis of characteristics of Cassava farmers

The use of frequency tables and percentages (%) in descriptive statistics is an important tool for the provision of information on certain variables and their relationship with farmers. As seen on Table 4.1 below, most farmers (62 %) are females meanwhile 38 % are males. The increase number of females in this sector (cassava) is because of varied reasons:

- Firstly, most men consider food crop cultivation as totally a woman affair as they (Men) are more engaged in the cultivation of cash crops (Cocoa, coffee and oil palm) which are the dominant sources of income for most rural households in Manyu division.
- In most parts of Manyu division, food crop production was carried out for immediate consumption as against commercialization. As such women who are always charged with the feeding of the family are those mostly involved in the cultivation of staple crops.
- Most women are also involved in auto financing. They therefore cultivate for both home consumptions while some of the produce which is always transformed only into water fufu (Akpu) and dried garri is commercialized in local markets and from traders who come from Nigeria.

This therefore implies that the cultivation of cassava is mostly done by women who cultivate small farmlands of between half (0.5) a hectare and one and a half (1.5) hectare. The reason for the small farmlands from the interviewees is not because of lack of access to land but because of the un mechanized nature of the activity as they invest small amount of capital in the course of the cultivation process. Also because the amount of labour needed for the cultivation is always provided only by women which makes it impossible to carryout large scale production. This attest to the conclusions of Adisa and Okunade (2005); Akinnagbe et al. (2008), Nsoanya and Nenna (2011) in which their results attested that women are the main actors in the agricultural sector.

From the results, (87.66 %) of the farmers are married and 12.33 % unmarried. The single respondents were those who are yet to marry, widowed and separated (divorced). Therefore, the respondents were overwhelmed by the married who uncontestably contribute to increase in household size and an increase in labour

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Table 4.1 The distribution of respondents by socioeconomic factors

Variables	**Frequency (n = 300)**	**Percentage (%)**
Gender (dummy variable)		
Male	115	38
Female	185	62
Marital status (categorical variable)		
Single	37	12.33
Married	263	87.66
Education Level (categorical variable)		
Had no primary education	16	5.33
Did not complete primary school	162	54
Finished primary school	119	39.66
Graduated from secondary school	03	1
Cultivation of cassava (dummy variable)		
Cultivate cassava	208	68
Do not cultivate cassava	92	32
Age (continuous variable in years)		
20–40	193	64.33

Variables	Frequency (n = 300)	Percentage (%)
41 and above	107	35.66
Households Size (continuous variable)		
1–4	134	44.66
5-7	166	55.33
Accessibility of information		
Had access to information	200	66.66
Had no access to information	100	33.33
Access to credit		
Had access to credit facilities	121	40.33
No access to credit	179	59.66
Membership in a common initiative group (CIG)		
Member of a CIG	177	59
Not a member of a CIG	123	41

Source: *Field Survey Data, 2019*

The level of education of respondents' shows that 5.33 % do not have primary education, 54 % had attempted primary school, 39.99 % attended and completed primary school meanwhile amongst all the respondents, 1% completed secondary school. Generally we can observe that the respondents (farmers) have acquired one form of education or the other, thus accounts for the variation in the adoption of innovative agricultural systems, since education helps in adopting improved agricultural techniques as stipulated by

Ozor and Madukwe (2005). It explains the reason why the farmers adopted one form of improved cassava variety (White stem).

A greater number of farmers (respondents) (68 %) are actively engaged in cassava cultivation though not all have cassava as their main crop because the cultivation of cassava is considered as a supportive agricultural activity either mostly carried out by women or as a staple crop for home consumption. Meanwhile 32% of the respondents mostly Men are not involved in the cultivation of cassava though admitted orally of having knowledge about its cultivation, support their women in the cultivation process mostly through financial assistance and some manual work like clearing of the farm and do partake in its consumption through family members and friends or purchase. The age distribution of the respondents was 20-40 years for what was termed the youthful population and those from 40 years and above termed the aging population.

The percentage of respondents between 20-40 years stood at 64.66% meanwhile those from 40 years and above was at 35.33%. This indicates that the youthful population was more actively engaged in the cultivation of cassava against the aging population. Implying that a greater proportion of the farmers are into active activities, they therefore have the advantage of sharing innovation which increases farm output. This analysis are in line with the studies of Onu and Madukwe (2002); Awotide et al. (2012); Babasanya et al. (2013) which attest that improved cassava varieties can easily be adopted in such areas.

The percentage of 44.66 % of farmers are said to have proportionate household sizes of ranging between 1-4 persons, meanwhile 55.33% of farmers had households of between 5–7. This increase the chances of adoption of better cassava cultivation techniques to meet up with increase needs and wellbeing of the family emanating from big family size, thus a subsequent increase in income. 66.66% had access to information on cassava varieties through radio and other sources of information meanwhile 33.33% never had this information.

The percentage of respondents opened to credit facilities was at 40.33% as against 59.66% who never had access to credit facilities. This credit was made possible through their local njangi houses and micro finance institutions located in Mamfe Town. Membership into a common initiative group (CIG) was quite encouraging as 59% attested to belonging to common initiative groups especially women. This therefore serves as a good avenue for the distribution and transmission of improved crop varieties and training respectively. On the contrary 41% attested of not belonging to any common initiative group.

Section 4.1.2 Description of trends associated with cassava innovation

Agricultural technology will have a direct or indirect effect only if farmers adopt it (Meinzen-Dick et al. 2004). Table 4.2 revealed that only 45% of respondents actually received a variety of cassava varieties (white stem) developed in the study areas, while the majorities (55%) were non-recipients. This may be due to their strong faith or reliance on the traditional varieties of cassava (Panya) used for planting or the unavailability of improved fruit for planting. The majority (45%) of farmers adopted a variety of white stems which were the only improved varieties to replace the six-month-old varieties that had disappeared. This six months' variety as of 2010 has been facing extinction caused by pest and disease attack, as the variety could no longer be resistant due to climatic changes.

Most farmers in the past five years (since 2014) therefore resorted reluctantly to the white stem and still concentrated on the local variety. Among the 55% of non-adopters, the reasons vary from community to community. In Mbakang for example respondents who have never adopted any improved variety was at 79.33% due to lack of access to improved varieties as compared to Bachountai that had a lesser number of non-adopters.

Fig 3. Picture of the white cassava stems at Ebam village

Source: (Photo by Author of work)

An issue of interest was also on the fact that after sampling the opinion of respondents whether they had knowledge on other varieties such as TMS 980505, TMS 980815 and TME 419, the results was at 8.69% as can be as shown in Table 3 below, probably due to ignorance of this type of cassava. There is a need to improve the spread of these new features in the study area and environments if researchers are convinced that they are actually improved and rewarding species

Table 4.2 Distribution of respondents by adopting advanced cassava varieties

Variable	Frequency	Percentage
Adoption of white stem		
Adoptors	135	45
Non-adoptors	165	55
Knowledge TMS 92/0326		
Yes	0	0.00
No	300	100%
Knowledge of TMS 96/1414		
Yes	00	0.00
No	00	100%
Knowledge of TMS 96/0023		
Yes	00	00
No	300	100

Source: Field Survey Data, 2019

Section 4.2 Empirical analysis

Section 4.2.1 Relationship between factors associated with R&D and innovation

Factors influencing the acceptance of advanced cassava varieties were assessed using a binary flow modeling model. Farmers who planted at least one cultivated variety in the past one year were classified as recipients as well as those who participated in the cultivation of traditional cassava varieties or short-term adopters and ceased to be identified as at the time of the survey were classified as non-recipients. The results from the logit model used in assessing factors affecting the acceptance of improved cassava varieties were obtained using the most probable guessing process and presented in Table 4.3.

The probability estimates of the logit model showed that the Chi-square figure of 80.09 was very significant ($p < 0.001$) suggesting that the model has a strong defining strength. The pseudo coefficient of multiple determinations (R2) of 19.8% reflects the variance of farmers' decision to accept improved cassava varieties in the study area was explained in part by independent variants. This is consistent with the effect of Omonona et al. (2006). The decision to adopt improved cassava varieties by farmers has been largely influenced by some of the social and economic factors. Among these were: marital status, education, access to information, information on at least one type of cassava, age, access to training, size of house, general group membership.

Table 4.3 Assessing determinants of acceptance of enhanced cassava varieties

Variable	**Coefficient**	**Standard error**	**P > |z|**	**Marginal effects (dy/dyx)**	**Standard Error**	**P>|z|**
Gender	-0.0825	0.2827	0.770	-0.0185	0.0634	0.769
Age	0.0076	0.2813	0.978	0.0017	0.0634	0.978
Marital Status	0.4773	0.4064	0.240	0.1009	0.0796	0.205
Education	-0.1299	0.2344	0.580	-0.0293	0.05293	0.580
Know one or less variety	2.4740	0.4247	0.000	0.4534	0.0517	. 0.000
Adoptors of new varieties	0.4866	0.2876	0.091	0.1102	0.0653	0.091
Membership of CIG	-0.0590	0.2786	0.832	-0.0133	0.06311	0.832
Access to training	0.2230	0.4080	0.585	0.0516	0.0965	0.593
Household size	0.0180	.0734	0.806	0.004	0.0165	0.806
Constant	-2.801	0.7197	0.00			
Number	300					
Wald chi2(9)	80.09					
Prob > Chi2	0.0000					
Pseudo R-Square	0.198					

y = Pr(duumydoptorsofnewvarieties) (predict) = .34441317

Note: *** = (P <0.01) Very important at 1%, ** = (p <0.05) Very important at 5%, * = (p <0.1) Very important at 10%

Source: Field research data, 2019

The marital status of the respondents had a positive correlation that was significantly higher at p <0.05, in the decision to accept improved cassava varieties in the study area. The positive and negative value of the marital status estimate indicates that married farmers are more likely to earn than single farmers. As farmers get married, the chances of getting improved cassava varieties increase by 10.09%. These findings contradict Amao and Awoyemi's (2008) study of the adoption of improved cassava varieties by farmers which showed that marital status is not a major solution to the acceptance of improved cassava varieties.

Increased access to improved cassava varieties in the marine environment may be due to the fact that the marriage raises the farmer's concern for the home's well-being and food security that may have a positive impact on their decision to adopt improved agricultural technology (Johnson et al. 2006; Annadi and Akwiwu, 2008). Also, the complete balance of knowledge of at least one improved cassava variety (p <0.1) proves its influence on the acceptance of improved cassava varieties by farmers. It contributes to increased opportunities for new species by farmers, because, awareness, access to information and planting materials positively affect acceptance.

Although cassava growers had a significant impact (p <0.01) on the acceptance of improved cassava varieties, the effect was negative on the prospects for acceptance of improved cassava varieties in the study area. The results showed that those who grow cassava in particular are 55% more likely not to use improved cassava varieties. This position was supported by the work of Diagne and Demont (2007) and could result in farmers losing knowledge of advanced cassava varieties as they do not attend meetings / training, and full-time farmers spend more time on the farm, thus not giving themselves the opportunity to know about improved cassava varieties.

Our result can also be explained by the fact that farmers have learned from the experience of planting traditional varieties and need to embrace new transformations. Information on improved varieties increases awareness - the farmer cannot use technology unconsciously (Diagne and Demont, 2007) With an increase of awareness of 66.66% and p <0.1 at least one type of ammunition, so there is an increase in farmers' willingness to use to improve cassava varieties, access to cutting improved urban cassava has the potential to increase farmers' acceptance of improved cassava varieties. The use of radio can create awareness and therefore increase the chances of discovery. It is also important to note that the percentage of people who had knowledge of more than one developed species was very low at 8.69% as can be seen in the descriptive summary analysis.

Table 4.4 Individuals who knew more than one variety

	Proportion	Standard Error	[95% Confidence. Interval]
Know more than one variety 0	0.9130	0 .01632	0 .8750 0 .9402
1	0.0869	0 .01632	0 .0597 0 .1249

Source: Author's work from Stata 14.0

Section 4.2.2 Relationship between other factors and innovation

Findings from the study showed that varieties characteristics such as taste can greatly affect the decision of farmers whether to adopt an improved variety or not. Varieties characteristics play a vital role in influencing farmers' adoption behavior. If the characteristics meet up with the need and interest of the farmers they will adopt (Tadesse, 2008) and vice versa. Over 43% of the respondents whom we interviewed revealed that though they have not been exposed to numerous varieties, they will only adopt improved cassava variety based on specific traits.

The year of farming experience had a positive and positive impact on the adoption of improved cassava varieties in rural households. Farmers with a greater number of years of experience and experience have shown more reluctance to acquire new varieties compared to young farmers who are more concerned with adopting new technologies. Also, 67.2% of respondents said that unreliable counseling services and a lack of training contribute to their negative acceptance or depend on the only available type of cassava available. According to Oluoch-Kosura et al., 2001 respondents who are not frequently visited by extension agents are less likely to be found than those who are regularly visited.

Table 4.5 Descriptive statistics on cassava productivity

Variable	Observation	Mean	Standard. Deviation.	Minimum	Maximum
Price	300	348333.3	230233	0	500000
Quantity (tons)	300	.491	.3841148	0	1
Cost of production	300	79364.55	61249.06	0	225000
Revenue from cassava	300	249750	205255.8	0	1500000
Productivity	300	170650	147143.4	0	1275000

Source: Author from Stata 14.0

The results also show that the acceptance of improved cassava varieties in the study area increases the annual income of the cassava growing families thereby increasing their well-being. As women who have played a major role in growing cassava they can contribute to family expenses. The acceptance of improved cassava varieties is therefore naturally poor for those with lower levels of poverty than those who do not. Significant relationships were found between farmers' marital status, farming as a major occupation, farming knowledge, and improved access to cassava cutting in the villages, the use of radio and the acceptance of improved cassava varieties.

GENERAL CONCLUSION

Recap of the Thesis

The expected outcome of this research is to draw a relationship between innovation and agricultural productivity. The reference area of study is a typical rural setting in Cameroon that has agriculture as its major economic activity. The conclusion from this studies reveals that this area has witnessed just two different cassava varieties for over two decades with the white cassava replacing six months' variety. The interesting thing about this study is on the fact that Manyu division is endowed with numerous opportunities for the cultivation and marketing of cassava and its associated products, but these opportunities have not been exploited or underutilized for the transformation of rural livelihoods.

The study was carried out through the assembling of primary data by providing 300 sample questionnaires to farmers in 19 villages in Manyu division. The results exposed both demographic and socio economic factors that determined farmers' adoption of improved cassava varieties. The studies therefore recommend the government and other stakeholders to establish an innovative platform in this area that will ensure the availability of improved cassava varieties and other facilities that will improve rural livelihood. This also falls in line with Cameroon's government decision to engage in second generation agriculture.

Main findings

New technologies and institutional change have a major impact on the transformation of the agricultural sector. New agricultural economics documents clearly state that new things do not happen randomly, but rather that government incentives and policies affect the environment and the level of innovation and acceptance. Both the development of new technologies and their adoption are affected by targeted public policies (e.g., research funding and extension activities), non-target policies (e.g. price manipulation), and private sector activities.

One of the challenges in developing technical policies for agriculture is to find a good mix of public and private efforts. The formulation of these policies will require an advanced economic understanding of the complex processes of innovation, learning, and acceptance in many institutional and technological fields. Economists have made great strides in their research on innovation and adoption, but much remains to be learned. It is within this backdrop that the need to improve on agricultural productivity through innovation is eminent especially in sub Saharan Africa which is being threatened by hunger and poverty.

This study assessed the extend through which research and development can play a role that is positive on agricultural productivity in Manyu division which is endowed with numerous opportunities to benefit from increase in investment in the cassava sector. These opportunities as outlined earlier range from its rich equatorial rainforest and favourable climate that is suitable for the cultivation of cassava, market availability through accessible road network to Nigeria and the rest of the country.

Impact of acceptance of improved cassava varieties which is an outcome of innovation is very much significant in cassava production. This studies carried out in some selected communities in Manyu division comes at a time when much efforts is very much needed in the agricultural sector. The commitment in research and development becomes irrelevant when the outcome can't get to end users who are the farmers no matter their status and location. Farmers in this area (Manyu division) for quite a long time have been faced with the problem of unavailability of improved varieties of cassava. This is evident from primary data available in the course of carrying out the filed analysis of this research thesis.

We are uplarged to look at the aspect of farmland sizes and information on availability of improved cassava varieties. The studies revealed that most farmers though cultivating on at most two hectares of land per annum, had encouraging productivity. It's sad to conclude that despite efforts put in place by research institutions in Cameroon, only one single specie of improved cassava variety big leaves (locally called six months) has been cultivated in this area for over two decades until it was recently replaced in 2014 by the new white stem. Despite its huge performance in the late-90s and early 2000s, many farmers had to abandon its cultivation mostly as a result of long run vulnerability to pest and diseases caused by climatic changes and lack of follow up by research institutions.

The studies as per adopters of at least one variety of improved cassava was highly determined by very interesting factors such as age, marital status, knowledge of at least one variety of cassava, cultivation of cassava and access to information. These factors gave us detailed analysis to understand how households' behaviors can be studied to improve on the distribution of innovated cassava varieties. In the welfare of cassava-producing households in the Manyu division with studies centered around Mamfe central and Eyumojcok sub divisions, it is the white stem variety which has been the most widely adopted variety and the only statistically among the varieties of cassava presented in the division at 45%.

RECOMMENDATIONS

There are a number of policy-related issues raised by this study. The government should put in place more policies to increase the adoption of cassava technology (improved varieties) in Manyu division and other rural settlements in Cameroon. In particular, these recommendations should address the following issues:

- The setting up of demonstration farms through innovative platforms communities that can help farmers learn the techniques of adopting new varieties of crops. Cassava produces more food energy per unit of arable land than any other basic crop in sub-Saharan Africa (De Bruijn and Fresco, 1989).
- Farmers should also be encouraged to increase the size of the cassava and other subsistence farms, to incorporate farmers' training programs through radio accessibility and the need to use advanced cassava technology, to give rural farmers more access to advanced cassava cutting within their villages.
- Sustainable agriculture should be at the center of research institutions. From observations on the field, rural farmers especially in Manyu division do not understand or take into consideration the environmental consequences of agricultural activities, which best sustainable agricultural method can be applied so much so that it will be about high yields and causing much smaller negative effects on the environment. Some of these methods fall in line with the usage of high yielding agricultural products cultivated on a smaller expanse of land.

It should be noted that the future of tropical forests is undoubtedly dependent on the people who leave and use them. Most of the activities that take place such as cleaning and burning are done by human activities with the following negative effects on the environment. The concept of sustainability has many facets. It can be used to mean economic sustainability, social sustainability, institutional sustainability and environmental sustainability (water and quantity, air quality, soil erosion, biodiversity, biodiversity, and land protection and food security and animal welfare). To ensure this improved productivity for the benefit of the actors involved and at the same time protecting our environment, it therefore necessitate uncompromised actions in sustainable research development within the agricultural family especially the cassava sector.

Many elements of SDG 2 such as: ending hunger and fighting malnutrition, access to food, right to own land, management of landscape, sustainable management of natural resources, fisheries, agriculture and food systems, addressing desertification concerns, putting a halt to agricultural biodiversity loss, reshaping trade policies and removing agricultural trade policies are all efforts through the United Nations Sustainable Goals (UNSG) to ensure sustainable human continuity.

By 2025, 83% of the world's expected 8.5 billion people will live in developing countries. However the capacity of the resources and technology needed to meet the needs of this growing nation of food and other agricultural products remains in doubt.

Agriculture needs to meet this challenge, especially by increasing agricultural production on already used land and preventing further entry of arable land.

Suggestions for Future Research

The increasing need of human knowledge and efforts to curb food insecurity can only be overcome through innovative ideas.

- ✓ Empirical studies have revealed that public investment in agricultural R&D have brought encouraging and high output to the society. Due to short comings associated with traditional methods such as patent rights protection, what are the appropriate tools necessary in comparing investments in social capital and linking them to policy makers?
- ✓ What can be the long and short run effects of increase in investment in private research in the agricultural sector?

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