ASSESSMENT OF USE OF INNOVATIVE TECHNOLOGY ON THE PRODUCTIVITY OF SMALLHOLDER FARMERS: CASE STUDY OF IFAD VALUE CHAIN DEVELOPMENT PROGRAMME IN EBONYI STATE, NIGERIA

FINAL REPORT

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ACRONYMS

ADPs - Agricultural development programmes

AfDB – African Development Bank

AMIS – Agricultural Market Information System

ATA – Agricultural Transformation Agenda

CAADP – Comprehensive Africa Agricultural Development Programme

CADP – Commercial Agricultural Development Programme

CBARDP – Community – Based Agricultural and Rural Development Programme

CAF- Commodity Alliance Forum

CESDEV- Centre for Sustainable Development

CGIAR – Consultative Group on International Agricultural Research

COSOP – Country Strategic Opportunities Programme

CPE – Community Programme Evaluation

CRP - CGIAR Research Program

FGN- Federal Government of Nigeria

FGD- Focus Group Discussion

FMARD - Federal Ministry of Agriculture and Rural Development

FO‟s- Farmer Organizations

IFAD- International Fund for Agricultural Development

GAP – Good Agronomic Practices

GDP – Gross Domestic Products

HH – Household

HQCF – High Quality Cassava Flour

IITA - International Institute of Tropical Agriculture

KI - Key Informant Interview

LGAs - Local Government Areas

MARD - Ministry of Agriculture and Rural Development

MDGs - Millennium Development Goals

M&E – Monitoring and Evaluation

MOU- Memorandum of Understanding

MT – Metric tonnes

NAIP – National Agricultural Investment Plan

NCRI - National Cereal Research Institute

NEEDS – National Economic Empowerment and Development Strategy

RBDA – River Basin Development Authority

SDGs – Sustainable Development Goals

SPMU – State Programme Management Unit

SPSS - Statistical Package for Social Sciences

SSA - Sub Saharan Africa

UNs- United Nations

UNDP – United Nations Development Programme

USAID – United States Agency for International Development

USD – United States Dollar

VC – Value Chain

VCDP- Value Chain Development Prog

VCO – Value Chain Organization

WB – World Bank

EXECUTIVE SUMMARY

The Global Masters in Development Practice based at the Earth Institute of the University of Columbia New York, United State in collaboration with International Fund for Agricultural Development (IFAD) commenced a graduate Win-Win Field Practicum Grant for student undergoing a study in development practice at all the Partner University of which University of Ibadan is the only partner university in Nigeria. In pursuit of strategic and sustainable development planning for the agricultural sector, the FGN and IFAD conducted the Country Programme Evaluation (CPE) in April, 2009 which recommended that IFAD's intervention be focused on agriculture using a value chain approach. The Value Chain Development Programme (VCDP) design which emerged from the IFAD Country Strategic Opportunity Programme (COSOP) covering the 2010-2015 period is consistent with the CPE recommendations and builds on other value chain interventions supported by government, development partners (DPs) and the private sector in Nigeria. It focuses on enhancing market access and productivity increases along commodity chains. Therefore this study is aimed at assessing the innovative technology use on the productivity of smallholder farmers: A case study of VCDP farmers Ebonyi State of Nigeria. using descriptive and inferential statistics. Four specific objectives were developed to guide the study. Purposive and simple random sampling techniques were employed in selecting 354 farmers who VCDP beneficiaries from the two benefitting local government areas. 354 out of the 360 copies of the questionnaire administered were retrieved and used for the study. Data for the study were obtained from primary source using interview schedule guided by structured questionnaire. Descriptive and relevant inferential statistics such as frequencies, percentages, mean, were used for data analysis.

CHAPTER ONE INTRODUCTION

1.1 Background to the Study

Agricultural sector is a key component of the Nigerian economy. Of the country's estimated 186 million people, (World Bank 2016) about 65 percent derive their livelihood from agriculture and related activities. Prior to the dominance of the oil sector since 1970s, agriculture was the mainstay of the Nigerian economy. The sector produces about two-thirds of the Gross Domestic Product (GDP), and the country used to be relatively self-sufficient in most of the staples and a leading producer of many export crops such as cocoa and groundnut. Despite the steady decline in the contributions of agriculture to the economy since the 1970s, it still remained an important sector accounting for about 42 percent of the GDP. The sector currently provides 88 percent of non-oil foreign exchange earnings and is critical as a major provider of raw materials and markets for the manufacturing sector. Some of the major problems facing farmers included: low productivity, limited opportunities for value addition; environmental degradation; limited access to productive assets and inputs; inadequate support services (extension and research); limited access to rural financial services; inadequate market and rural infrastructure (including water supply); post-harvest losses and a constrained enabling environment

FNG/ IFAD Assisted Value Chain Development Programme

This programme takes a holistic and demand-driven approach to addressing constraints along the cassava and rice value chains. It does so through an inclusive strategy, strengthening the capacity of actors along the chain including producers and processors as well as public and private institutions, service providers, policy-makers and regulators.

At the same time, the programme strongly emphasizes the development of commodity-specific Value Chain Action Plans at the local government level, which serve as the basis for rolling out sustainable activities to reduce poverty and accelerate economic growth. The objective is to sustainably enhance rural incomes and food security. The target groups include 15,000 smallholder farming households, 1,680 processors and 800 traders.

Specifically, the programme focuses on:

- Developing agricultural markets and increasing market access for smallholder farmers and small to medium-scale agro-processors

- Enhancing smallholder productivity and thus increasing the volume and quality of marketable produce by strengthening farmers' organizations as well as supporting smallholder production.

IFAD's support to the Nigerian Government's poverty reduction programme in rural areas targets large numbers of smallholder farmers and is essentially people-centered. IFAD supports programmes and projects that work with communities, with smallholder farmers as the key players. The organization also promotes commodity-based interventions that provide technical and financial support along several value chains such as livestock products, rice and other cereals, roots and tubers, vegetables and agroforestry products.

The objectives are to empower poor rural people, especially women, by increasing their access to resources, infrastructure and services; and to promote the management of land, water and common property by local communities, helping to overcome environmental degradation. IFAD-supported programmes and projects address issues such as erosion and the loss of soil fertility, as well as coastal zone natural resource management.

The Value Chain Concept

The term “value chains” was conceived in business management studies. Porter (1985) tailored the concept as a basic framework for developing a corporate strategy to promote firm competitiveness by directing attention to the entire system of activities involved in producing and consuming a product.

Value chain analysis is a strategic analytical and decision-support tool that highlights the bases where businesses can create value for their customers. The framework can also be applied to identify sources of competitive advantage for businesses. Value chain is a set of consequent activities that businesses perform in order to achieve their primary objective of profit maximization. The value chain concept has several dimensions: The value chain flow also called input-output, the geographic spread and the control that different actors can exert. The concept of value chain encompasses the issues of organization and coordination; the strategies and the power relationship (including gender concerns) of the different actors in the chain. The three main pillars of the VCA, namely production, processing and marketing of the produce, are the main aspects that relate directly to the food security

framework. The reason for the existence of a value chain is that goods, services or information are passed on between different actors.

The Value Chain Development Programme (VCDP) emerged from the IFAD Country Strategic Opportunities Programme (COSOP) covering the 2010-2015 period. This COSOP built on the recommendations of the Country Programme Evaluation (CPE) carried out in 2008/2009 April 2009 by the Federal Government of Nigeria (FGN) and IFAD. The CPE recommended to focus future IFAD interventions on agriculture, with emphasis on enhancing productivity and access to market. The VCDP design is consistent with the CPE recommendations and builds on ongoing value chain (VC) interventions supported by Government, development partners (DPs) and the private sector in Nigeria. The VCDP is fully aligned with the National Agricultural and Food Security Strategy, the National Policy on Integrated Rural Development/Rural Development Sector Strategy and the National Agricultural Investment Plan (NAIP) of the Government of Nigeria. It addresses all five core components of the NAIP: (i) agricultural productivity enhancement; (ii) support to commercial agriculture; (iii) land management and water control; (iv) linkages and support to inputs and product markets; and (v) programme coordination, monitoring and evaluation. The Programme directly contributes to achieving the overall development targets of the NAIP1.

Cassava Value Chain

Cassava provides a reliable and inexpensive source of carbohydrates for people in Sub-Saharan Africa, where consumption is the highest per capita in the world (Westby, 2008). 88 percent of cassava that are produced in Africa is consumed by humans, 50 percent of which is processed. High quality cassava flour (HQCF) is of particular interest because it can be used as a substitute for 10 percent or potentially more wheat flours in pies, pastries, cakes, biscuits and doughnuts and has some industrial applications (Ndossi quoted in Gwera, M., 31 Marcg 2009).

Beyond these industrial uses of cassava, which utilize HQCF, processed cassava holds other potential uses including sweeteners, mosquito coils, livestock feed, and brewing ingredients. Sweeteners derived from cassava compete with beet and cane sweetners. Livestock feeds rely primarily on dried cassava pellets and can be used domestically or exported. Use of processed cassava however is highly dependent on quality and price, which relates significantly to processing efficiency and on farm yields.

Tapping the consumption and industrial potentials of cassava requires elimination or minimizing the production, processing and marketing impediment that smallholder farmers face.

Rice Value Chain

Rice is extremely important and food and cash crop in Nigeria. With total annual rice production at about 2 million metric tons (MT), it is the fourth largest cereal crop grown in the country after sorghum, millet and maize. However, since Nigeria also imports about 2.5 – 3 million metric tons of Rice, total annual consumption exceeds 5million MT per year, or more than 30 kg per capita per anum. Rice is rapidly becoming the preferred staple food in the urban areas where annual consumption exceeds 47kg/capita farmers sell 80 percent of the rice they produce, making it a very important source of income for smallholder producers, complementing other agricultural production. Considering that total sales of rice exceeded $5 billion per year, $3 billion of which are from imports, implying that there is a significant rice market in Nigeria.

The value chain for domestically produced rice is currently dominated by a largely fragmented production and milling industry, with limited new investment in either production or processing, while the returns are quite good at each stage of the traditional value chain channel, there are so many participants in the channel that the benefits are spread very thinly and few have any incentive to invest. With very high prices, a protected market and ever increasing imports, the potential is high to promote a strong supply response under the right conditions.

1.2 PROBLEM STATEMENT

Nigeria's target of achieving economic expansion through agribusiness is steadily being hit by poor value chain development in the sector, which makes it hard for all the relevant players to predict the outcomes. One of the objectives of modern agriculture is to reduce to the barest minimum the problems associated with the value chain system.

The Nigerian Agricultural Value Chain has not been at premium in its performance because of the myriads of challenges and inefficiencies confronting its elements. In Nigeria, there is much focus on primary production; huge crop turnover/harvest, large flock management, enormous plantations e.t.c. Nigerian farmers pride themselves in being the World Largest producers of certain food crops, the

major question one must not fail to ask is that despite all these agricultural feats, why is the agricultural sector still underdeveloped? Production efficiency which could have been realized from the processing of our massively harvested crops is lost. Our major pitfall is on the issue of packaging and standardization which has ousted us from the Global Market to our own economic detriment. This research intends to explore and to establish the developmental relationship between microfinance and livelihood status of the indirect beneficiaries.

1.3 OBJECTIVE OF THE STUDY

Main Objective

The overall objective of this work is to assess the level of use of innovative technology on the productivity of smallholder VCDP farmers in Ebonyi State.

Specific Objectives are to:

i. To determine the existing technologies and technological gaps in the value chains among smallholder farmers in Ebonyi State

ii. investigate the factors influencing technological use and innovations in the value chain among smallholder farmers in Ebonyi State

iii. evaluate the extent of the impact of technological use and innovations on the performance of the value chain among smallholder farmers in Ebonyi State

Table1. Analysis of objective, data collection and method of analysis.

S/N	Objectives	Data Collection	Data Required	Method Of Analysis
1	To identify the existing technologies and innovative use adopted in the value chains by smallholder farmers	Focus group discussion, key informant interview, individual interviews (Structured questionnaire)	Information on existing technology and innovative use in the value chain	Descriptive statistics (frequencies, percentages, charts and cross tabulation)
2	investigate the factors influencing technological use and innovations in the value chain among small	Individual interviews (Structured questionnaire)	Information on existing technology and	Means and inferential statistics (T-test), binomial

	holder farmers		innovative use in the value chain and socio-demographic factors (Age, gender, marital status e.t.c)	regression.
3	evaluate the extent of the impact of technological use and innovations on the performance of the value chain among smallholder farmers	Focus group discussion, Key informant Interview and structured interview, Questionnaire.	Data on change in yield, livelihood assets e.t.c.	Frequencies and percentages. Means and inferential statistics (chi-square test, ANOVA).
4	determine the empowerment index of the beneficiaries.	Focus Group Discussion and questionnaires.	Empowerment index for males and females	Women Empowerment in Agriculture Index

1.4 Significance of the Study.

The significance of this study cannot be over emphasized Small-scale farmers in Africa and elsewhere in the world often say that receiving low prices for their produce is a major challenge. Typically, a farmer waits for traders to visit his farm. The trader offers a low price and won't buy the entire crop. The farmer is unhappy – her time and effort are not well-rewarded. She may blame the trader for her problems. Farmers and traders often fight over prices. Farmers may cheat traders by putting low-quality produce at the bottom of crates, and traders may cheat farmers by using inaccurate weights and measures. There is often a lack of trust between the two. This results in the value chain not working as well as it could, which means worse outcomes for everyone. The trader sells the farmer's produce to a processor, who supplies a wholesaler, who supplies a retailer, who supplies a consumer, with transport and other links in between. Each player in this chain adds value, and in return receives an economic return, usually called "economic rent." The amount each actor in the chain receives varies between different products and value chains. But the price the farmer receives for his raw goods is only a small fraction of the price paid by the consumer.

Figure 1 Focused group discussion with beneficiaries of VCDP

2.0 LITERATURE REVIEW

2.1 Brief Historical Background

Increasing rice productivity and acceptability, enhancing better marketing, poverty alleviation and increasing value addition of rice through the rice value chain are some of the major targets of Nigeria government over the years. Value chain is the full range of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use (Kaplinsky and Morris 2001). Production, processing, marketing, and consumption of rice are moving towards high-value food products. In response, food production portfolio is diversifying. These changes are creating opportunities as well as challenges in production and marketing dynamics (Birthal et al., 2007).

Agricultural productivity remains low and declining at farm levels in Nigeria (World Bank 2013). This trend can be traced to a number of factors. First, the concept of innovation has for long been interpreted in the Nigerian agricultural system in terms of focusing only on research, to the exclusion of other components of the innovation system. Second, several agricultural research outcomes are either undocumented, or documented but largely not linked to development and diffusion processes. Stated

differently, several agricultural technologies that would have boosted agricultural productivity remain largely on the shelves and, consequently, unknown. Three, funding for the generation, development and adoption of agricultural technologies in Nigeria have remained low in relation to the annual national budget, giving little hope to promoting the agricultural sector as the hub for improving food security, agricultural income, employment and foreign exchange earnings. These problems need urgent solutions and, probably, new strategies. Nigeria and, indeed, developing countries need not to ‘reinvent the wheel’ by investing in productivity-enhancing technologies that already exist; advances in science, technology and engineering elsewhere already make available adaptable options. Also, with proper documentation and improved collaborations among actors, on-shelf technologies can be revisited and developed to the adoption stage, with incremental collaborative investments. This will, in turn, require embracing a broader definition of innovation that involves farmers, extension workers, researchers, seed companies, government officials and many others. And it would require careful coordination of individuals and institutions that make up the innovation system in Nigeria.

A number of studies have been carried out on the adoption of improved technologies singly and independently (Shiferaw and Holden, 1998; Zeller et al., 1998; Alene et al., 2000; Oluoch-Kosura et al., 2001; Abdoulaye and Sanders, 2002; Bamire et al., 2002; Akinola et al., 2010). According to von Braun (1988), agricultural growth via technological transformation leads to an expanded food supply which presupposes relationship between production and processing operations in agriculture. Greene (2000) and Maddala (1983) posited that most studies on adoption have reflected farmers-, farm-, institutional and technology-specific factors based on analysis that identified and estimated separately in a single equation model. Measures of wealth such as off-farm income and income from other sources apart from processing were also hypothesized to influence adoption positively. They are generally considered to be capital that could be used either in the production process or be exchanged for cash or other productive assets. They are expected to influence the adoption of the technologies positively (Shiferaw and Holden, 1998; Zeller et al., 1998; Negatu and Parikh, 1999). Agricultural technology is a major driver of agricultural productivity, as agriculture becomes increasingly technology-intensive, farmers' ability and willingness to adopt new technologies is key to productivity growth and structural transformation, which in turn determines the poverty reduction rate in settings where most of the poor still live in rural areas. The ability to adapt quickly to exogenous changes will also increase in importance as, in the context of climate change, the frequency and severity of extreme weather events is likely to increase significantly. Agriculture progresses technologically as farmers adopt innovations, the extent to which farmers adopt available innovations and the speed by which they do so determines the impact of innovations in terms of productivity growth. Adoption of innovations by farmers is inevitably affected by many factors. In general, farmers will adopt a particular technology if it usefully suits their socioeconomic and agro-ecological circumstances. The availability of improved innovative technology, access to "modern" inputs and resources, and profitability at an acceptable level of risk are among the critical factors in the adoption process. Adoption can be influenced by educating farmers about improved varieties, cropping techniques, optimal input use, prices and market conditions, more efficient methods of production management, storage, nutrition, etc. To do so, extension agents must be capable of more than just communicating messages to farmers. They must be able to comprehend an often-complex situation, have the technical ability to spot and possibly diagnose problems, and possess insightful economic-management skills in order to advise on more efficient use of resources.

2.2 RICE

Rice (*Oryza sativa*) is perhaps the world's most important food crop being the staple food of over 50 percent of the world population, particularly of India, China and a number of other countries in Africa and Asia (FAO,2006). It is one of the major cereals, and has assumed cash crop status in Nigeria, especially in the producing areas, where it provides employment and income for more than 80% of the inhabitants as a result of the activities that take place along the production and distribution chains from cultivation to consumption (Imolehin, 1991). Due to its increasing contribution to per capita calorie to Nigerians, the demand force has been increasing at a much faster rate than in any other African countries since 1970's (WARDA, 2001). Rice has become part of everyday diet of many in Nigeria. Both rice production and its consumption (demand) is growing faster than for any other major staples because consumption is broadening across all socio-economic classes.

Rice is one of the most consumed staples in Nigeria, with a consumption per capita of 32kg. In the past decade, consumption has increased 4.7%, almost four times the global consumption growth, and reached 6.4 million tonnes in 2017 – accounting for c.20% of Africa's consumption. As at 2011, rice accounted for 10% of household food spending, and 6.6% of total household spending*. Given the importance of rice as a staple food in Nigeria, boosting its production has been accorded high priority by the government in the past 7 years. Significant progress has been recorded; rice production in Nigeria reached a peak of 3.7 million tonnes in 2017. Despite this improvement, comparatively, Nigeria's rice statistics suggest there is an enormous potential to raise productivity and increase production. Yields have remained at 2 tonne per hectare, which is about half of the average achieved in Asia. In addition, as population increases, along with rural to urban migration, ensuring food security in key staples becomes critical. However, food security cannot be achieved by a system that depends almost entirely on human muscle power and other manual methods. Nigeria's mechanization has remained low at 0.3 hp/ha, relative to 2.6hp/ha in India and 8 hp/ha in China. The number of agricultural tractors is estimated around 22,000, relative to 1 million and 2.5 million in China and India respectively. Low income, limited access to affordable financing and the lack of technical skills have limited the adoption of mechanization across the rice value chain. Rice is a common food staple consumed by 1over 50% of the world's population. It provides 19% of global

human per capita 2energy and 13% of per capita protein. Hence, rice production is critical to global food security. Rice is grown on more than 144 million 3rice farms, mostly smaller than 1 hectare. This makes rice an important source of employment and income, particularly for the rural people.

2.2.1 Rice production continues to rise, driven by mechanization

Global rice production has grown at an annual average of 1.0% over the past decade, reaching 486.7 million tonnes in 2017. Most of this growth has come from Asia, accounting for 89% of global output. China and India are the largest producers, each with a share of 29.6% and 22.6% of global production respectively. In the rest of the world (ex-Asia), rice production has risen steadily over the past decades, accounting for 15% of total production by 2017, a marginal increase from 12% in the last two decades.

2.3.1 CASSAVA

Cassava (Manihot spp) is widely grown in Nigeria and it is one of the most popular food crops cultivated by small scale farmers (Nweke, 1996). In recent years, there is growing realization that given the number of by-products that can be obtained from industrial processing of cassava tubers, more hectarage would need to be devoted to cultivation of the crop. The popularity of cassava grew further in Nigeria in the last four years with the inauguration of the Presidential Task Force on Cassava Revolution, which promotes cassava cultivation on a commercial scale and process harvested products into various byproducts like cassava flour, cassava chips, ethanol and industrial starch for export. Johnson and Kellog (1989) stated that one of the most important means of accelerating national development in nations with large agricultural sector is the development and adptation of new agricultural technologies like improved crop cultivars that can be adopted by small scale farmers. Progress in agricultural development in Nigeria depends to some extent on the willingness and ability of farm families to adopt new farm technologies that are being popularized. Different cassava varieties and several techniques of its production and processing have been developed and disseminated but farmers responses have depended on their perception of benefits derivable from given varieties, socio-cultural suitability and profitability of the production and processing techniques. Despite the release of different cassava varieties in Nigeria, cassava output per hectare of local farmers is still low (Chukwuji, 2006). This can partly be attributed to farmers continued use of local cassava cultivars or landraces based on known characteristics such as colour,

texture, taste and adaptability to mixed cropping systems which form bottlenecks to adoption of improved cultivars.

Nigeria produces more than half of total world cassava. But most of the cassava is traditionally consumed by processing the fresh roots into garri, fufu, and flour (Adebayo et al., 2003a; Adebayo et al, 2003b). The crop gained national prominence as a potential foreign exchange earner for the nation following the pronouncement of a Presidential Initiative on Cassava in 2002. But this cannot be achieved without the uptake of key innovations that tend toward higher levels of commercialization in cassava production and processing. Since, traditional cassava processing takes place predominantly in rural areas, it is important that rural people adopt appropriate cassava processing technologies along with cassava production technologies for any meaningful impact to be made on the food system.

The development and introduction of improved cassava varieties has long been recognized as one of the key strategies for transforming the cassava industry and for enhancing the wellbeing of Nigeria's rural population (Dixon and Ssemakula 2008). The other key strategies applied include value addition, as well as markets and an enabling policy environment. Cassava breeding programs in the country initially addressed viral disease epidemics. With close and strategic collaborations between the International Institute of Tropical Agriculture (IITA), the International Center for Tropical Agriculture (CIAT), and national agricultural research programs, about 59 early-bulking, disease-resistant, and high-yielding cassava varieties have been officially released since 1977 (Dixon et al. 2010). These varieties include the Tropical Manioc Selection (TMS) varieties from the IITA and the National Root Crop Research Institute, Umudike (NRCRI) materials (or NR varieties). From 1990 to 1998, about 14 percent of the germplasm incorporated into the development of varieties released from IITA across Africa was sourced from landraces, while 2 percent and 80 percent were sourced from CIAT and IITA, respectively (Manyong et al. 2000).

2.3.2 CASSAVA PROCESSING TECHNOLOGIES

Processing is important for the marketing of cassava, and reduces the bulk, extends shelf life thereby reducing transportation cost. Fresh cassava roots have low value per unit weight; whereas processing adds value to it and therefore increases the market value. In addition, fresh roots of some cassava

cultivars contain cyanogens which are reduced or eliminated through processing. In response to growing labour shortages in Nigeria, researchers have developed a wide array of simple mechanical processing technologies that reduce labour requirements and facilitate the commercial production of cassava and its processing into traditional food items. Research Institutes such as Product Development Agency (PRODA), Federal Institute of Industrial Research Oshodi (FIIRO), and International Institute of Tropical Agriculture (IITA), as well as the Agricultural Engineering Departments in several Universities and Polytechnics in the country, have developed many mechanized units designed to remove the constraints that cassava processors face. Thus, several models and variations of mechanical cassava graters are available in the market (Taiwo, 2006). Graters powered by petrol or diesel engines are in general use, but not much success has been recorded towards mechanizing cassava peeling and *gaari* frying (labour – intensive operations) at the household level. However, the industrial *gaari* fryers developed by PRODA, FIIRO, and IITA are more suitable for use in large-scale commercial enterprises or cooperative organizations than at the household level. Equipment for milling cassava chips and grains also are available in the market (Adeniji *et al,* 2001; Taiwo *et al,* 2001). However, the adoption of cassava post-harvest technology especially at the rural and peri-urban settings in Nigeria seems to be hampered by its fuel (energy) consumption. Most available cassava processing machines are driven by petrol, diesel or electrical energy, and for most rural households, these are scarce and expensive energy sources (Taiwo, 1998).

Technology can also be defined as a general term for the processes by which human beings fashion tools and machines to increase their control and understanding of the material environment (Merritt, 2008). Technology is the most important factor that can contribute to growth in agricultural productivity. The use of technology in agriculture involves the application of technological innovations into production, storage and processing of agricultural products to improve the efficiency. These improvements include the use of mechanization in farming, the use of chemicals to control diseases and pests, the use of fertilizers, new tillage practices, introduction of improved plant and animal species and so on. The major contributions of agricultural technology are an increase in farm productivity resulting in increased income and poverty reduction, food security and others (Department for International Development United Kingdom-DFID, 2004). The availability of these innovations or technology for agricultural production is one step in the process of improved agricultural production, the next and most important step is the adoption of these improved production technologies by the farmers. The adoption of new technology is described as an

innovation decision process through which an individual pass through the time of first knowledge of the innovation to a decision stage of either adoption or rejection and confirm the decision (Ekong, 2003). It is the stage in which an individual (in this case the farmer) decides to use a new technology. The adoption of any technology is dependent on the profitability of the technology, the risk and uncertainty associated with it, the initial capital requirement, socio-economic characteristics of the farmers and cultural/traditional belief systems. The increase in productivity associated with improved technologies can only be reaped if the farmers adopt the technology. It is believed that the adoption of new agricultural technology, such as the high yielding varieties that kick-started the green revolution in Asia, could lead to significant increases in agricultural productivity in Africa and stimulate the transition from low productivity subsistence agriculture to a high productivity agro-industrial economy (World Bank, 2008). In this regard, Mendola (2007) observes that the adoption of high yielding varieties has had a positive effect on household well-being. In addition, empirical studies show that gains from new agricultural technology influenced the poor directly, by raising incomes of farm households and, indirectly, by raising the employment and wage rates of functionally landless laborers, and by lowering the price of food staples (de Janvry and Sadoulet, 2002; Irz et al., 2002; Bellon et al., 2006; Evenson and Gollin, 2003; Diagne et al., 2009).

Research findings carried out by some scholars and Institutes on technology adoption in developing countries on factors that influenced technology adoption can be grouped into the following three broad categories (Feder et al., 1985): (1) factors related to the characteristics of producers; (2) factors related to the characteristics and relative performance of the technology and (3) institutional factors. Nasiru (2014) stated that the factors related to the characteristics of producers include educational level, experience in the activity, age, gender, level of wealth, farm size, labour availability, risk aversion, etc. He asserted that the factors related to the characteristics and performance of the technology include food and economic functions of the product, the perception of individuals of the characteristics, complexity and performance of the innovation, its availability and that of complementary inputs, the relative profitability of its adoption compared to substitute technologies, the period of recovery of investment, the susceptibility of the technology to environmental hazards etc. He further opined that the institutional factors include availability of credit, the availability and quality of information on the technologies, accessibility of markets for products and inputs factors, the land tenure system, and the availability of adequate infrastructure etc. Also, Matata et al. (2001) listed factors like personal, institution, environmental and socio-

economic factors as influencing technology adoption. Adesina and Baidu-Forson (1995) found that age was negatively related to probability of participating in rice development projects, though Asante et al. (2011) recorded a positive relationship.

2.4 SMALLHOLDER FARMERS

The cost of producing food in first world countries is extremely high and land is scarce; but on the other hand, sub-Saharan Africa has enormous natural, physical and human potential. The focus of the agricultural finance donor community has shifted away from food aid and is now focused on developing smallholder farmers and establishing food security. The stage is being set for food production in Africa to gain momentum. Africa's small farmers are unique in that they generally have access to land that is free (communally held) or can be used at a relatively low cost. This free/low cost land provides farmers with a significantly lower cost structure (Akinsuyi, 2011). Constraints to smallholder farming in Nigeria Smallholder farming is faced with a lot of challenges which include the following:

2.4.1 Lack of support from local government councils (LGCs)

Various LGCs in Nigeria do not provide the services stipulated in 2001 Nigerian Agricultural Policy as a result of many challenges. They mainly buy and distribute fertilizers at subsidized prices, provide land for some agricultural programmes. Due to poor funding, low staff strength, poor attitude of workers and embezzlement by LG officials, among other constraints, the impact of LGCs is not felt agriculturally by smallholder farmers. Lack and high cost of labour in rural areas. Small holder farmers have problems with availability of adequate labour in the rural area because able-bodied men are no longer interested in farming. They rather become commercial motor cyclists or taxi drivers than work in the farms. They also migrate to big cities to access social amenities and white collar jobs for better living. This resulted in scarcity and high cost of labour in rural areas. Lack of information to small holder farmers Information is an essential ingredient in agricultural development programmes but Nigerian farmers seldom feel the impact of agricultural innovations either because they have no access to such vital information or because it is poorly disseminated. Often, agricultural information is not integrated with other development programmes to address the numerous related problems that face farmers. There are some limiting factors and apparent constraints to agricultural information dissemination in Nigeria, including status differences between

extension agents and their clients; agents' inadequate knowledge of how communication works; lack of interagency cooperation both in programme planning and implementation; and the extension's general lack of interest in traditional media. The ineffectiveness of smallholder farmers in Nigeria can also be attributed to the treatment of information delivery as a matter of course by most African governments. The non-provision of agricultural information is a key factor that has greatly limited agricultural development in developing countries. Ozowa (1995) observes that the agricultural information provided is exclusively focused on policy makers, researchers, and those who manage policy decisions with less attention paid to the information needs of the targeted beneficiaries of the policy decisions. It is safe to assert that the information needs of Nigerian smallholder farmers revolve around the resolution of problems such as pest hazards, weed control, moisture insufficiency, soil infertility, inadequate farm credit, labour shortage, soil erosion and so forth. Ozowa (1995) grouped the information needs of smallholder farmers into five headings: agricultural inputs; extension education; agricultural technology; agricultural credit; and marketing. Modern farm inputs are needed to raise small farm productivity. These inputs include fertilizers, improved variety of seeds and seedlings, feeds, plant protection chemicals, agricultural machinery, equipment and water. An examination of the factors influencing the adoption and continued use of these inputs will show that information dissemination is a very important factor. There are many improved agricultural innovations from our universities and research institutes not properly diffused.

2.4.2 Limited access to modern agricultural technology

According to Odoemenem and Obinne (2010), there is very limited access to modern improved technologies and their general circumstance does not always merit tangible investments in capital, inputs and labour. Agricultural technology for the smallholder farmer must help minimize the drudgery or irksomeness of farm chores. It should be labour-saving, labour-enhancing and labour-enlarging. The farmer needs information on production technology that involves cultivation, fertilizer application, pest control, weeding and harvesting. This sort of information is at the moment being diffused by extension workers, other farmers, government parastatals and agricultural equipment dealers but the impact is yet to be felt (Ozowa, 1995)).

Agricultural technology contributes significantly to nation-building and economic growth through its roles in agricultural production and farming household welfare services. However, the traditional

contribution to agricultural production has been rendered inefficient by the simple traditional and inappropriate form of agricultural technologies frequently used (Olawoye,1988; Awoyemi 2000). The result is a relatively low agricultural productivity which is inversely proportional to the enormous labour intensive input. It is therefore important that the use of appropriate technology by cassava farmers will improve their contributions to national development and that they will adopt improved technology if such technology is suited to their need, appropriate for their peculiarities and culture and available within their means, save time, conserve energy and are compatible with the local environment of the users. Such technology must be adaptable to the ecological climatic and physical conditions in order to be functionally relevant. Technology has made pertinent contributions to national progress and its usefulness has attained universal recognition both at national and international levels. In many developing countries including Nigeria, lack of appropriate technological and scientific knowledge application limits agricultural and economic progress (Odebode, 1997). In order to keep pace with the rapid rate of food demand, that is attendant upon rapid population growth and help to improve the gloomy food situation and its consequences, continuous research in food production and efficient extension services is highly desirable. Technology is very crucial to development. Many developed countries rely on land and labour within the existing national environment with increasing population, which invariably increased demand for more agricultural products. Technology is indispensable in the fight against hunger, food shortage, food insecurity and low productivity (Afolami 1997). It enhances agricultural production, fosters education and training, promotes information dissemination and facilitates effective utilization of natural resources.

2.4.3 Lack and high cost of farm inputs.

The International Food Policy Research Institute, in its Nigeria Strategy Support Programme document says that the average smallholder farmer in Nigeria does not have access to sufficient fertilizer for one hectare. Yields require a combination of education through extension services, access to appropriate and timely inputs as well as access to finance to purchase inputs (Opara, 2011). International Fund for Agricultural Development (IFAD) (2009) observes that a number of negative factors that militate against high productivity in small scale farming in Nigeria include: (i) a large proportion of small-scale agriculture is uncompetitive, and is neither profit-/business-oriented nor sustainable; (ii) there is a vicious circle of low productivity and income, total shortages of cash, and

limited investments or input availability/use; and (iii) the lack of market access and of credible processing and trading outlets also hinders improvements in or expansion of production. For example, an effective distribution system is needed to give smallholders access to fertilizer at affordable prices and help them remain competitive. The existing seed and planting material industries are underdeveloped, and supplies are often of substandard quality.

2.4.4 Land tenure system

Among the major problems facing the small scale farmers is land for farm use in promoting agricultural development because of the land tenure system that Nigeria operates. Nwalieji and Igbokwe (2011) report that acquisition of land for new entrants into farming is one of the agricultural roles of local government councils that have not been achieved. Smallholder farmers lack capital, hence they do not acquire land for agriculture. Unavailability of land is one of the serious problems militating against small scale farming in Nigeria. Inadequate agricultural credit Smallholder farmers' productivity and growth are hindered by limited access to credit facilities (Odoemenem and Obinne 2010). According to the authors, agricultural credit encompasses all loans and advances granted borrowers to finance and service production activities relating to agriculture, fisheries and forestry and also for processing, marketing, storage and distribution of products resulting from these activities.

3.0 CHAPTER THREE THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Introduction

The objective of this section is to measure the impact analysis of the innovative technology as introduced by the IFAD VCDP on the productivity of the smallholder farmers in Ebonyi State. Various innovative technologies have been introduced to the smallholder farmers. It is our main aim in this research to assess the impact of these innovations and technological intervention are indeed catalysts of change, increased productivity and yield and livelihood enhancement of the smallholder farmers

3.2 Study Area

Nigeria is a country in West Africa. Nigeria shares land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. Its coast lies on the Gulf of Guinea in the south and it borders Lake Chad to the northeast. Noted geographical features in Nigeria include the Adamawa highlands, Mambilla Plateau, Jos Plateau, Obudu Plateau, the Niger River, River Benue and Niger Delta.The countryis found in the Tropics, where the climate is seasonally damp and very humid. Nigeria is affected by four climate types; these climate types are distinguishable, as one move from the southern part of Nigeria to the northern part of Nigeria through Nigeria's middle belt.

At more than 190 million people, the population of Nigeria is the largest in Africa and accounts for 47 percent of West Africa’s total population (World Bank 2012). Nigeria is also the biggest oil exporter in Africa, with the continent’s largest natural gas reserves. Nigeria’s oil wealth has helped it maintain relatively steady economic growth despite recent global financial downturns. The country’s GDP grew from 6 percent in 2008 to 8.4 percent in 2010 (World Bank 2012). Unemployment

remains a significant problem, however, with an estimated 50 million youth unemployed. The government in 2011 launched a comprehensive public works program to stimulate employment and expand vital infrastructure and services.

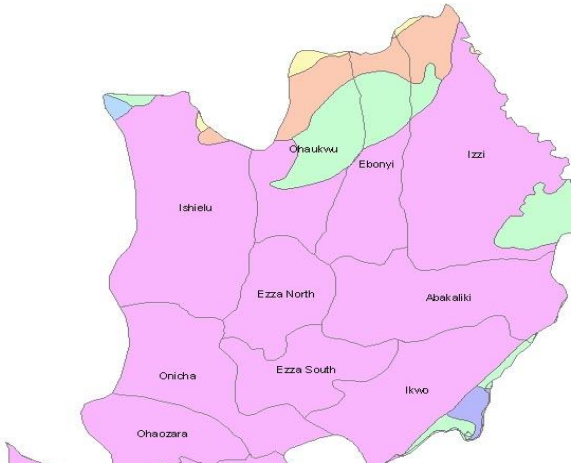
3.3 State of Study Area

The research was carried out in Ebonyi State of Nigeria, one of the states participating in the VCDP initiative of the FGN and IFAD programme on the improvement of Rice and cassava value chains for small holder farmers. Agriculture is the primary economic activity of a majority of its citizens and its economy is based largely on subsistence crops, livestock, internal markets and export of raw commodities. Ebonyi is primarily an agricultural region. It is a leading producer of rice, yam, potatoes, maize, beans, and cassava in Nigeria. Rice and yams are predominantly cultivated in Edda, a region within the state.

3.4 Historical Perspectives

Ebonyi is a state in southeastern Nigeria. It is inhabited and populated primarily by the Igbo. Its capital and largest city is Abakaliki. Other major towns include Afikpo, Onueke, Edda, Onicha, etc. It was one of the six states created in 1996 by the then federal military government. The State of Ebonyi was created from parts of both Enugu State and Abia State, which in turn were initially constituents of the old Anambra and Imo States respectively. It has three senatorial zones (north, south & central), thirteen local government areas as well as local development centres created by the state government.

There are several Igbo dialects spoken in Ebonyi State, the most prominent being the Izi-Ezza-Mgbo-Ikwo dialect cluster, Afikpo, Edda, Okposi, Onicha and Uburu. Ebonyi State consists of thirteen (13) Local Government Areas. They are: Abakaliki, Afikpo North, Afikpo South (Edda), Ebonyi, Ezza North, Ezza South, Ikwo, Ishielu, Ivo, Izzi, Ohaozara, Ohaukwu, Onicha.



4.0 CHAPTER FOUR ANALYSIS AND RESULTS

4.1: SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF FARMERS

This section contains the socio-economic and demographic information of the farmers who participated in the study. Information such as age, gender, marital status, household size, monthly income, highest education level attained, farm size, type of enterprise unit, and type of crop enterprise.

The table below reveals the descriptive statistics of a few of the variables. It was obtained that the least and highest age among the interviewed farmers were 26 years and 72 years respectively, with a mean age of about 43 years, and a standard deviation of approximately 8 years.

The results of the farmers' household size revealed a minimum and maximum size of 1 and 30 persons respectively, with an average household size of approximately 7 persons, and a standard deviation of 3.9. The results of the monthly income showed a minimum and maximum amount of 5000 and 400,000 (naira) respectively, with an average monthly income of about 41,500 (naira), and a standard deviation of about 37,000 (naira). The responses obtained on the farm size showed a minimum and maximum of 1 and 10 hectares respectively, with an average farm size of 2.2 hectares, and a standard deviation of about 1.3 hectares.

Table 1: Descriptive Statistics (Overall Farmers)

	Min.	**Max.**	**Mean**	**Std. Dev.**

Age (yrs.)	26	72	43.27	7.99
Household Size	1	30	7.25	3.88
Monthly Income	5000	400,000	41,428.9	37,007.4
Farm Size (Ha)	1	10	2.18	1.32

Source: Field Survey, 2018

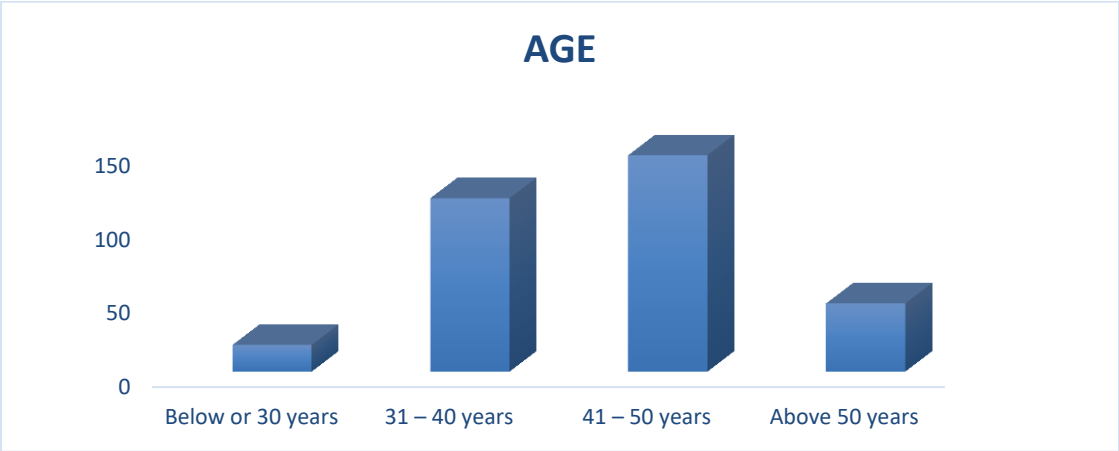


Figure 1. Chart showing Age Distributions of the Farmers

The distribution of the farmers according to their age group reveals that about 5.5% were below 30 years; about 36% belonged to age groups 31 – 40 years; about 45% belonged to age group 41 – 50 years; and lastly, about 14% had ages above 50 years.

Table 2: Categories of Respondents by Age Groups

Characteristics		**Frequency**	**Percentage**
Age Group	**Below or 30 years**	**18**	**5.5**
	31 – 40 years	117	35.8
	41 – 50 years	146	44.6

	Above 50 years	46	14.1

Source: Field Survey, 2018

Table 3: Categories of Respondents by Household Size

Characteristics		Frequency	Percentage
Household Size	Below 5 persons	73	21.9
	5 – 9 persons	180	54.1
	10 – 14 years	61	18.3
	15 or more persons	19	5.7

Source: Field Survey, 2018

The distribution of the respondents according to their age group reveals that about 22% had household size of below 5 persons; 54% were reported to have housed size of 5 – 9 persons; 18% were reported to have household size of 10 – 14 persons; while about 6% reported to have over 15 persons in their household.

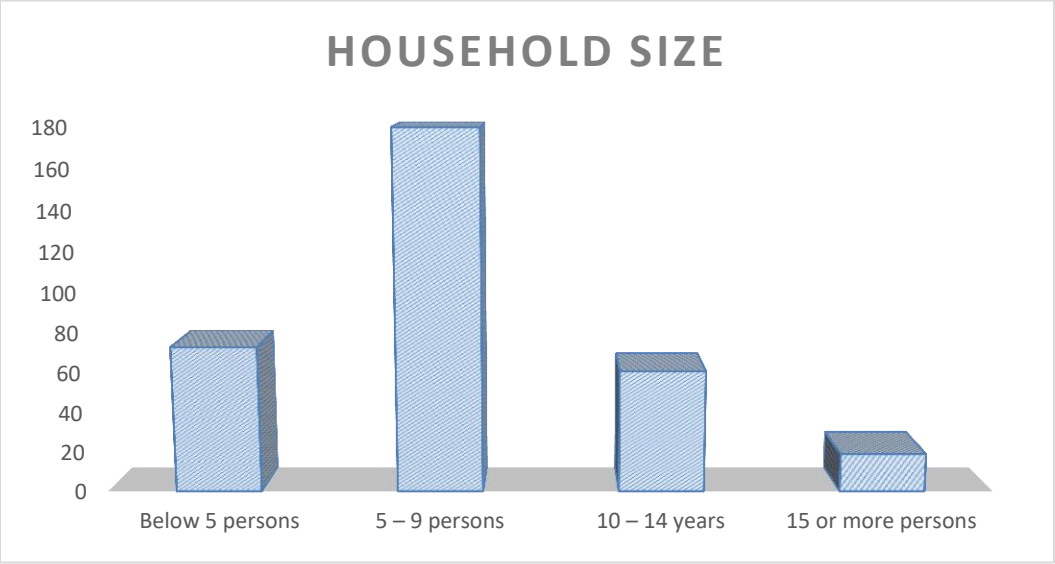


Figure 2. Chart showing the Household size of the Farmers

Table 4: Categories of Respondents by Monthly Income

Characteristics		Frequency	Percentage

	Below 30,000	111	33.3
Monthly Income (Naira)	30,000 – 49,000	14	43.2
	50,000 – 69,000	46	13.8
	70,000 or more	32	9.6

Source: Field Survey, 2018

The distribution of the farmers according to their monthly income shows that about 33% reported to earn below 30,000 (naira) on monthly basis; about 43% reported to earn between 30,000 – 49,000 (naira) on monthly basis; about 14% indicated to earn between 50,000 – 69,000 (naira) on monthly basis; about 10% indicated to earn 70,000 (naira) or more every month.

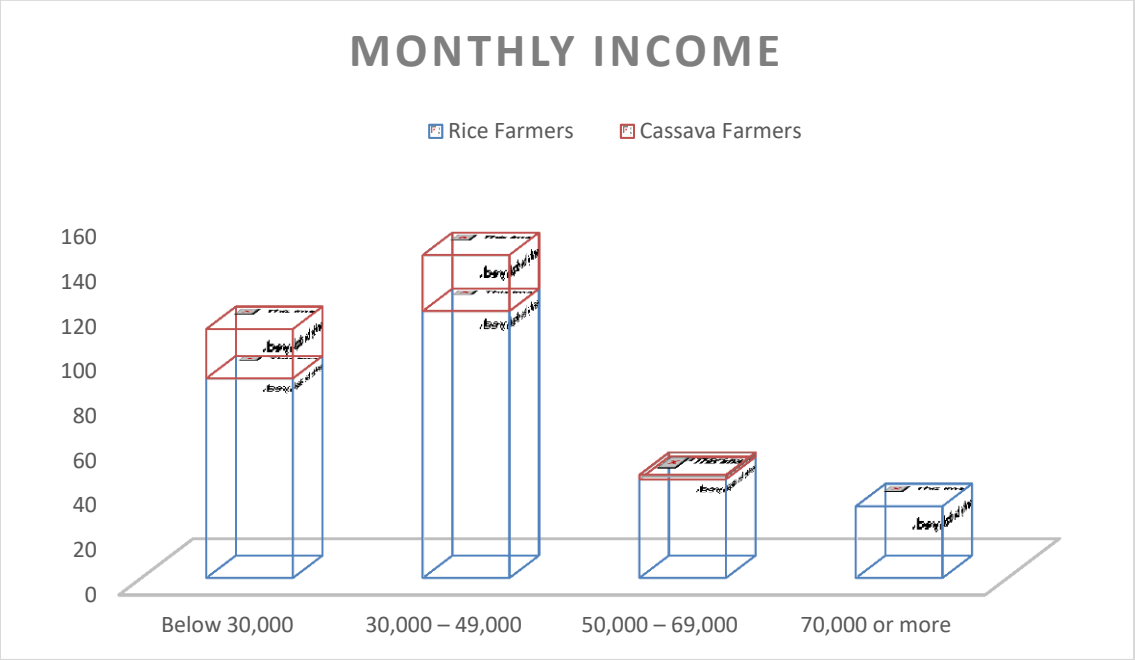


Figure 4 Chart showing the Monthly Income of Respondents

Table 5: Categories of Respondents by Farm Size

The distribution of the farmers according to their farm sizes showed that the most of them, about 79%, had below 3 hectares of farm land; about 19% were reported to have farm sizes of about 3 – 5 hectares; while about 2% had farm size of over 5 hectares of land.

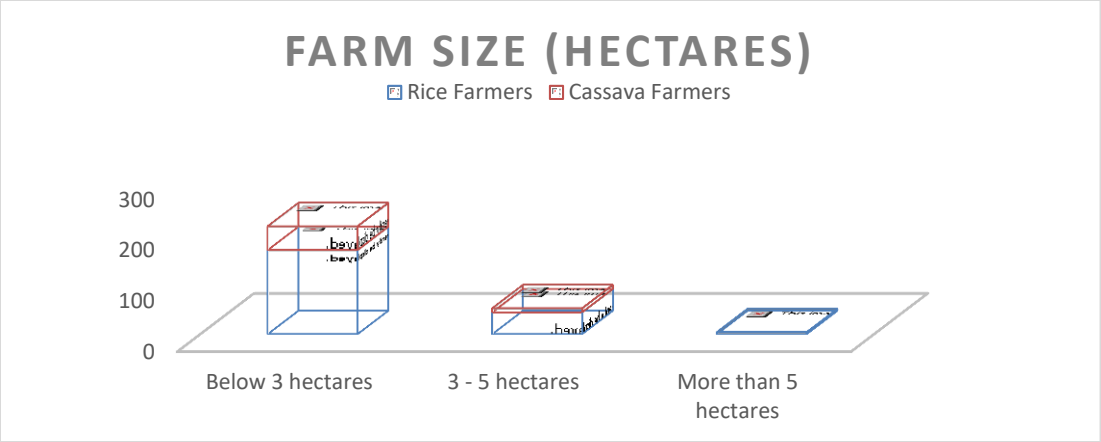


Figure 5 Chart showing the Farm Size of the Respondents

Table 6: Categories of Respondents by Gender

The distribution of the respondents according to their gender showed that 71% of the interviewed farmers were males, while about 29% of the interviewed farmers were females.

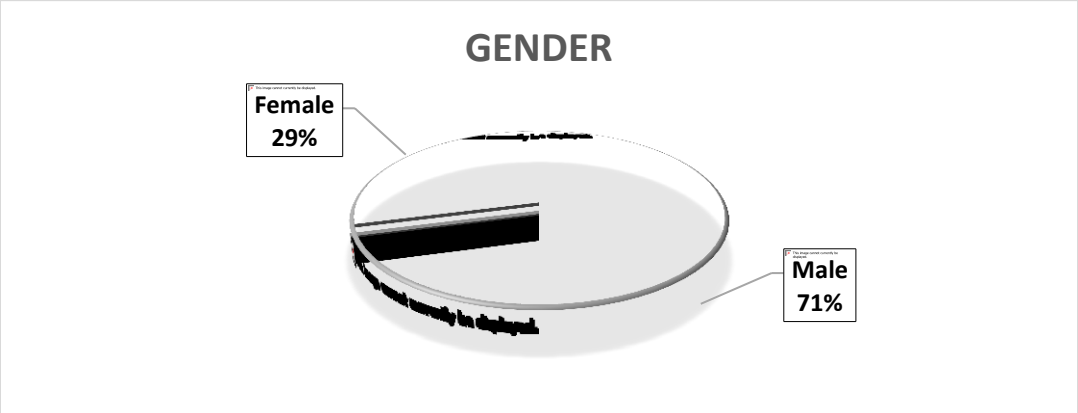


Figure 6: Pie Chart showing the Gender Distribution of the Farmers

Table 7: Categories of Respondents by Marital Status

The distribution of the farmers according to their marital status showed that the majority of them, amounting to about 91% were married persons; about 6% were reported to be single or never married; the remaining 3% were reported to be separated or divorced or widowed.

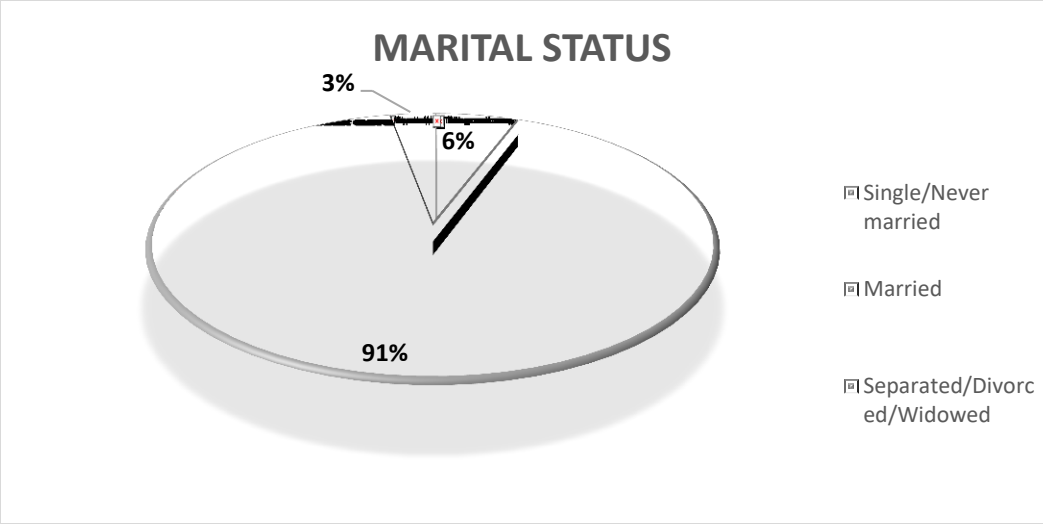


Figure 7: Pie Chart showing the Marital Status of the Farmers

Table 8: Categories of Respondents by Educational Level

Characteristics		Frequency	Percentage
Highest Education Attainment	No formal education	12	3.4
	Primary education (not completed)	22	6.3
	Primary education (completed)	61	17.4
	Secondary school (not completed)	116	33.1
	Secondary school (completed)	137	39.1
	Post-secondary school	2	0.6

Source: Field Survey, 2018

The distribution of the respondents according to their educational level showed that the most of the interviewed farmers, about 39%, had completed secondary school education; about 33% were reported as not having completed secondary school education; almost 17% were reported to have

completed only primary education; 6% were reported to have not completed primary education; about 3% were reported to have no formal education; while less than 1% were found to have post-secondary school education.

Table 9: Categories of Respondents by Type of Enterprise

Characteristics		Frequency	Percentage
Type of Enterprise	Producer only	262	74.4
	Processor only	9	2.6
	Producer and processor	12	3.4
	Producer and marketer	65	18.5
	Processor and marketer	4	1.1

The distribution of the respondents according to their type of enterprise showed that about 74% of the interviewed farmers were producer only; about 19% of them were producer and marketer; not than 3% were producer and processor; up to 3% were processor only; and lastly, not more than 1% were processor and marketer.

Table 10: Categories of Respondents by Type of Crops

Characteristics		Frequency	Percentage
Type of Crops	Rice	297	83.9
	Cassava	57	16.1

Source: Field Survey, 2018

The distribution of the respondents according to the type of crop they cultivate revealed that about 84% of the farmers were rice farmers, while the remaining 16% were cassava farmers.

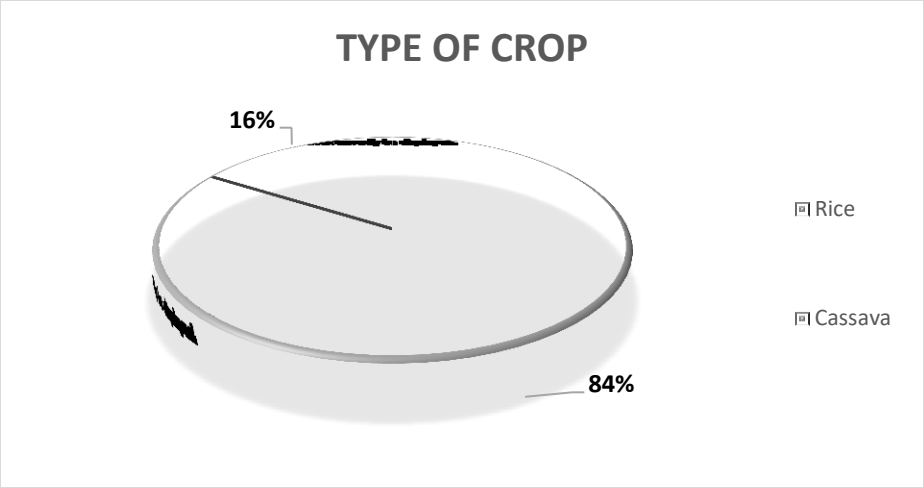


Figure 8: Pie Chart showing the Distribution of the type of crop grown by the Farmers

ACCESS TO PRODUCTION INPUTS

This section reveals information provided by the farmers based on their access to various production inputs, sources of their production inputs and quantity of each input acquired before the intervention and during the intervention.

Responses obtained among rice farmers showed that about 98% of them had access to improved seeds; about 99% of them indicated they had access to fertilizers; approximately 99% indicated they had access to pesticides/herbicides; 30% indicated they had access to tractor coupled implements; not more than 3% indicated they had access to other production inputs.

Table 11: Responses on access to production inputs among rice farmers

	Have Access		No Access	
	Freq.	**Perc.**	**Freq.**	**Perc.**
Improved seeds	283	97.6	7	2.4
Fertilizers	287	99.0	3	1.0

Pesticides/Herbicides	286	98.6	4	1.4
Tractor Coupled Implements	84	30.2	194	69.8
Others	7	2.6	261	97.4

Source: Field Survey, 2018

Responses obtained among cassava farmers showed that about 89.5% of them had access to cassava cuttings; about 93% of them indicated they had access to fertilizers; about 86% indicated they had access to pesticides/herbicides; almost 25% indicated they had access to tractor coupled implements; lastly, not more than 7% indicated they had access to other production inputs.

Table 12: Responses on access to production inputs among cassava farmers

	Have Access		**No Access**	
	Freq.	**Perc.**	**Freq.**	**Perc.**
Cassava cuttings	51	89.5	6	10.5
Fertilizers	53	93.0	4	7.0
Pesticides/Herbicides	49	86.0	8	14.0
Tractor Coupled Implements	14	24.6	43	75.4
Others	4	7.0	53	93.0

Source: Field Survey, 2018

SOURCES OF INPUTS

As seen on Tables (i) to (v) of the Appendix section, the most common source of rice seeds among rice farmers has been from service providers, as indicated by about 96% of the rice farmers. Only about 58% of

the cassava farmers indicated they got their cassava cuttings from service providers, while about 28% indicated they got their cassava cuttings from fellow farmers. Among the entire farmers, about 90% indicated they got their fertilizers from various service providers around them. About 97% indicated they got their pesticides/herbicides from service providers. Lastly, about 82% indicated they also got their tractor coupled implements from service providers.

QUANTITY OF INPUTS AMONG FARMERS

The results of the quantity of inputs used by the farmers before intervention and as at last year were shown on table 13 and table 14 below. Information on land cultivated, fertilizers, pesticides/herbicides, and number of labourers employed (man/day).

Table 13 reveals the descriptive statistics of the input quantity among rice farmers, as obtained before the intervention and as at last year (during the intervention). The results showed that the least and highest observed land cultivated before VCDP were 0.2 hectares and 5 hectares respectively, with an average of 1.2 hectares and standard deviation of 0.73; while the least and highest observed land cultivated as at last year (during the VCDP) were 1 and 10 hectares respectively, with an average of 2 hectares and standard deviation of 1.14.

It was also obtained that the amount of fertilizers used among rice farmers before VCDP were 1.5kg and 2000kg at least and highest value respectively, with an average usage of 176kg of fertilizer; while as at last year (during the VCDP), the amount of fertilizers used were 6kg and 16000kg at least and highest value respectively, with an average usage of 528kg of fertilizers.

The results also revealed that the minimum and maximum record of pesticides/herbicides used, among rice farmers, before VCDP were 1 liter and 36 liters respectively, with an average usage of 4 liters; while the minimum and maximum records of pesticides/herbicides as at last year (during the VCDP) were 3 liters and 60 liters respectively, with an average usage of about 10 liters.

The employment of labour, among rice farmers, before the VCDP showed that the least and highest record were 1 person/day and 150 persons/day, with an average of 39 persons/day; while as at last year (during the VCDP), the least and highest record were 5 persons/day and 400 persons/day, with an average of about 52 persons/day.

Table 13: Descriptive Statistics on Input Quantity among Rice Farmers

	Before VCDP				Last Year			
	Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Land cultivated (Ha.)	0.2	5.0	1.19	0.73	1	10.0	2.1	1.14
Fertilizers (kg)	1.5	2000	176.25	213.5	6	16000	528.12	980.28
Pesticides/ Herbicides (ltrs)	1	36	4.42	3.85	3	60	9.55	5.79
Labour (man/day)	1	150	39.26	23.41	5	400	52.27	43.84

Source: Field Survey, 2018

Hypothesis 1: There is no difference in the quantity of input used by Rice Farmers before VCDP and during VCDP ($\alpha = 5\%$)

The paired sampled t-test was used to test for difference in consumption of inputs among the rice farmers, as seen on table 14. It was obtained that there was a statistically significant difference in the quantity of all the inputs used (land cultivated, fertilizers, pesticides/herbicides, and labour), as the p-values were generally less than 0.05.

Notably was that, prior the VCDP, there was a general increment in quantity of input used among these rice farmers since the commencement of the intervention programme. The Pearson Product Moment correlation coefficient indicated there is a positive strong correlation between the sizes of land cultivated before and during the VCDP (r = 0.64); thus implying the size of land cultivated by the rice farmers before VCDP increased proportionally since the inception of the VCDP. The correlation coefficient indicated there is positive strong correlation between quantity of pesticides/herbicides used before and during VCDP (r = 0.75); thus implying there is a proportional

increase in the quantity of pesticide/herbicides used by the rice farmers since the intervention programme began.

The correlation coefficient also indicated there is positive strong correlation between number of human labour hired before and during VCDP (r = 0.52); thus implying the number of human labour hired by the rice farmers before and during the VCDP is directly proportional.

Table 14: Test of Hypothesis on Input Quantity Used Before VCDP and During VCDP (among rice farmers)

		Average Land Area (Ha.)	Average Land Difference (Ha.)	r	t-value	P-Value
Land Cultivated	**Before VCDP**	1.19	−0.92	0.64	−17.34	0.00
	Last Year	2.11				
Fertilizers	**Before VCDP**	175.8	−351.27	0.16	−5.93	0.00
	Last Year	527.1				
Pesticides/Herbicides	**Before VCDP**	4.42	−5.33	0.75	−19.39	0.00
	Last Year	9.75				
Hired Labour	**Before VCDP**	39	−13	0.52	−5.75	0.00

	Last Year	52				

Source: Field Survey, 2018

Table 14 reveals the descriptive statistics of the input quantity among cassava farmers, as obtained before the intervention and as at last year (during the intervention). The results showed that the least and highest observed land cultivated before VCDP were 0.5 hectares and 10 hectares respectively, with an average of 1.1 hectares and standard deviation of 1.86; while the least and highest observed land cultivated as at last year (during the VCDP) were 1 and 20 hectares respectively, with an average of 2.4 hectares and standard deviation of 3.7.

It was also obtained that the amount of fertilizers used among cassava farmers before VCDP were 50kg and 400kg at least and highest value respectively, with an average usage of 152kg of fertilizer; while as at last year (during the VCDP), the amount of fertilizers used were 100kg and 700kg at least and highest value respectively, with an average usage of 372kg of fertilizers.

The results also revealed that the minimum and maximum record of pesticides/herbicides used, among cassava farmers, before VCDP were 2 liters and 5 liters respectively, with an average usage of 3 liters; while the minimum and maximum records of pesticides/herbicides as at last year (during the VCDP) were 4 liters and 12 liters respectively, with an average usage of about 7 liters.

The employment of labour, among cassava farmers, before the VCDP showed that the least and highest record were 3 persons/day and 70 persons/day, with an average of 28 persons/day; while as at last year (during the VCDP), the least and highest record were 8 persons/day and 150 persons/day, with an average of about 45 persons/day

Table 15: Descriptive Statistics on Input Quantity among Cassava Farmers

	Before VCDP				Last Year			
	Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Land cultivated (Ha.)	0.5	10	1.13	1.86	1	20	2.39	3.70

Fertilizers (kg)	50	400	152.83	84.59	100	700	371.70	190.65
Pesticides/ Herbicides (ltrs)	2	5	3.22	1.08	4	12	6.55	2.67
Labour (man/day)	3	70	28.04	20.15	8	150	45.39	39.78

Source: Field Survey, 2018

Hypothesis 2: There is no difference in the quantity of input used by Rice Farmers before VCDP and during VCDP ($\alpha = 5\%$)

The paired sampled t-test was used to test for difference in consumption of inputs among the cassava farmers. It was obtained that there was a statistically significant difference in the quantity of all the inputs used (land cultivated, fertilizers, pesticides/herbicides, and labour), as the p-values were generally less than 0.05.

Notably was that, prior the VCDP, there was a general increment in quantity of input used among these cassava farmers since the commencement of the intervention programme. The Pearson Product Moment correlation coefficient indicated there is a positive strong correlation between the sizes of land cultivated before and during the VCDP (r = 0.99); thus implying the size of land cultivated by the cassava farmers before VCDP increased proportionally since the inception of the VCDP. The correlation coefficient indicated there is positive strong correlation between quantity of pesticides/herbicides used before and during VCDP (r = 0.79); thus implying there is a proportional increase in the quantity of pesticide/herbicides used by the cassava farmers since the intervention programme began.

The correlation coefficient also indicated there is positive strong correlation between number of human labour hired before and during VCDP (r = 0.73); thus implying the number of human labour hired by the cassava farmers before and during the VCDP is directly proportional.

Table 16: Test of Hypothesis on Input Quantity Used Before VCDP and During VCDP (among cassava farmers)

		Average Land Area (Ha.)	Average Land Difference (Ha.)	r	t-value	P-Value
Land Cultivated	**Before VCDP**	1.13	−1.25	0.99	−4.68	0.00
	Last Year	2.39				
Fertilizers	**Before VCDP**	152.83	−218.87	0.35	−8.90	0.00
	Last Year	371.70				
Pesticides/Herbicides	**Before VCDP**	3.22	−3.33	0.79	−11.09	0.00
	Last Year	6.55				
Hired Labour	**Before VCDP**	28	−17	0.73	−4.57	0.00
	Last Year	45				

Source: Field Survey, 2018

EXTENT OF THE IMPACT OF TECHNOLOGICAL USE: PRODUCTION YIELD AMONG FARMERS, LIVELIHOOD ASSETS AMONG FARMERS, AND FARMERS' PERCEPTION OF IMPROVEMENT ON INPUTS AND ASSETS

To determine the extent of impact of the intervention technique and use of technology, table 15 and table 16 reveals the production yield among rice farmers and cassava farmers respectively, before the intervention technique and as at last year (during the intervention). Table 17 shows the income levels of the rice and cassava farmers, separately, before the VCDP and during the VCDP.

Table 15 showed the production yield among the rice farmers; it was revealed that the quantity of produce harvested was lowest and highest before VCDP at 0.15 tonnes and 12 tonnes respectively, with an average yield of about 2.5 tonnes and standard deviation of 1.75 tonnes; while during the VCDP, measured as at last year, the lowest and highest at 0.12 tonnes and 40 tonnes respectively, with an average yield of about 7.8 tonnes and standard deviation of 4.5 tonnes.

Table 17: Production Yield among Rice Farmers

	Before VCDP				Last Year			
	Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Quantity Harvested (Tonnes)	0.15	12	2.47	1.75	0.12	40	7.81	4.47

Source: Field Survey, 2018.

Table 16 showed the production yield among the cassava farmers; it was revealed that the quantity of produce harvested was lowest and highest before VCDP at 1.4 tonnes and 15 tonnes respectively, with an average yield of about 7.8 tonnes and standard deviation of 4.4 tonnes; while during the VCDP, measured as at last year, the lowest and highest at 8 tonnes and 60 tonnes respectively, with an average yield of about 24 tonnes and standard deviation of 14.2 tonnes.

Table 18: Production Yield among Cassava Farmers

	Before VCDP				Last Year			
	Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Quantity Harvested (Tonnes)	1.4	15	7.83	4.37	8	60	23.96	14.15

Source: Field Survey, 2018

Hypothesis 3: There is no difference in the production yield by the farmers before VCDP and during VCDP ($\alpha = 5\%$)

The paired t-test was also used to test if there was a difference in the production yield recorded before VCDP and during VCDP among the rice farmers and cassava farmers. It was obtained that the p-values of the tests were less than 0.05 for both rice farmers and cassava farmers. Hence, there

is a statistically significant difference in the yield produced before the VCDP and during the VCDP, for both rice farmers and cassava farmers.

Notably was that, there was an increment in their quantity of their yield as at last year, as compared to prior the VCDP.

Table 19: Test of Hypothesis on Production Yield Before VCDP and During VCDP

		Average Yield (Tonnes)	Average Difference in Yield	r	t-value	P-Value
Rice Farmers	**Before VCDP**	2.65	−5.16	0.09	−15.29	0.00
	Last Year	7.81				
Cassava Farmers	**Before VCDP**	7.83	−16.13	0.62	−9.26	0.00
	Last Year	23.96				

Source: Field Survey

The table below shows the income levels of the farmers. It was revealed that the lowest and highest amount recorded on monthly basis among the rice farmers, before the VCDP, was 500 (naira) and 200,000 (naira) respectively, with an overall average income of about 28,000 (naira); while during the VCDP, as at last year, lowest and highest monthly income among the rice farmers were 10,000 (naira) and 800,000 (naira), with an overall average income of about 58,000 (naira).

The table below the income levels of the farmers. It was revealed that the lowest and highest amount recorded on monthly basis among the cassava farmers, before the VCDP, was 5,000 (naira) and 280,000 (naira) respectively, with an overall average income of about 23,000 (naira); while during the VCDP, as at last year, lowest and highest monthly income among the cassava farmers were 15,000 (naira) and 600,000 (naira), with an overall average income of about 36,000 (naira).

Table 20: Monthly Income Level before and during VCDP among Rice and Cassava Farmers

	Rice Farmers				**Cassava Farmers**			
	Min.	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**

Before VCDP	500	200,000	28,298.63	23,955.12	5,000	280,000	23,333.33	36,274.91
During VCDP	10,000	800,000	58,317.98	67,917.46	15,000	600,000	35,912.28	11,918.29

Source: Field Survey, 2018

Hypothesis 4: There is no difference in the income level of the farmers before VCDP and during VCDP ($\alpha = 5\%$)

The paired t-test was also used to test if there was a difference in the production yield recorded before VCDP and during VCDP among the rice farmers and cassava farmers. It was obtained that the p-values of the tests were less than 0.05 for both rice farmers and cassava farmers. Hence, there is a statistically significant difference in the yield produced before the VCDP and during the VCDP, for both rice farmers and cassava farmers.

Notably was that, there was an increment in their quantity of their yield as at last year, as compared to prior the VCDP. The correlation coefficient showed that there is strong positive correlation in the income of rice farmers before and during VCDP (r = 0.78); thus implying the observed increment in income level of the rice farmers before and during VCDP is directly proportional.

Table 21: Monthly Income Level before and during VCDP among Rice and Cassava Farmers

		Average Income	**Average Difference in Income**	r	**t-value**	**P-Value**
Rice Farmers	**Before VCDP**	28,298.6	−30,019.35	0.78	−9.95	0.00
	Last Year	58,317.9				
Cassava Farmers	**Before VCDP**	23,333.3	−12,578.9	0.22	−2.67	0.01
	Last Year	35,912.3				

Source: Field Survey, 2018

Table 18 below shows the perception of the farmers on their improvement towards farm inputs and assets possessed before their participation on the VCDP and during the VCDP.

Enquiry made to find out their perception towards improvement on the size/number of landed property owned revealed that the most of them, about 65%, indicated they had been improving; while about 33% indicated there was no change. Enquiry made on size of dwelling units showed that 68% of the farmers indicated they had been improving since the commencement of the intervention, while about 31% indicated there was no change. Responses obtained on the quality of dwelling unit showed that about 86% had undergone improvement since the beginning of the intervention, while about 14% indicated they had not notice any change in their quality of dwelling units. Responses on their means of transport showed that about 80% indicated there has been an improvement in their transportation means since their participation in the intervention technique, while not more than 18% indicated there was no improvement in their transportation means.

Further enquiry to find out if the pattern of change in the hectares of land under irrigation owned showed that only about 14% indicated they had observed a significant improvement, while about 13% reported there has been no change, the larger portion, about 73%, of them reported they did not own farmlands that were under irrigation, thus the enquiry was not applicable. Findings on the change pattern on their crop cultivated showed about 92% reported that there has been an improvement in the quality of the crops they cultivated since the intervention technique, while about 4% reported they had not notice any change. Findings on the harvesting system showed that up tom 71% reported an improvement on their harvesting system, while about 22% reported no change in their harvesting system. About 55% also reported there has been an improvement in their access to use of farm machinery since the intervention technique, while about 29% reported there has been no change in their access to farm machinery.

The findings on financial assets showed that, about 98% reported that there has been a significant improvement in their income level since their participation in the VCDP. About 87% reported there has been improvement in their household savings since their participation on VCDP, while about 10% indicated they had not experienced any change. Not more than 60% indicated they have had an improved access to credit since the intervention began, while about 31% indicated there has been no change. The observed pattern changes in the business assets owned revealed that about 62% reported a significant improvement, while about 29% indicated they had not experienced any change.

Furthermore, up to 90% reported an improvement in their profit making since the commencement of the intervention, while not more than 8% reported there has been no change in their profit making.

Table 19: Responses on Improvement Pattern Among Farmers

	Worsened	No Change	Improving	Not Applicable
Size/number of landed property owned	-	117 (33.1%)	229 (64.7%)	8 (2.3%)
Size of dwelling unit	-	110 (31.4%)	238 (68.0%)	2 (0.6%)
Quality of dwelling unit	-	50 (14.2%)	302 (85.6%)	1 (0.3%)
Means of transport	-	64 (18.2%)	282 (80.3%)	5 (1.4%)
Electrical appliances	1 (0.3%)	71 (20.9%)	211 (62.2%)	56 (16.5%)
Hectares of land under irrigation	-	45 (13.2%)	48 (14.1%)	247 (72.6%)
Hectares under improved management	-	24 (6.8%)	319 (90.6%)	9 (2.6%)
Crops cultivated	-	14 (4.0%)	321 (92.2%)	13 (3.7%)
Livestock water points	3 (0.9%)	54 (16.7%)	80 (24.7%)	187 (57.7%)
Harvesting system	-	78 (22.2%)	250 (71.0%)	24 (6.8%)
Farm machinery	4 (1.1%)	102 (29.1%)	194 (55.4%)	50 (14.3%)

Income	-	5 (1.4%)	347 (98.3%)	1 (0.3%)
Household savings	6 (1.7%)	37 (10.5%)	306 (86.7%)	4 (1.1%)
Access to credit	13 (3.7%)	108 (30.7%)	210 (59.7%)	21 (6.0%)
Business assets	5 (1.4%)	101 (29.1%)	215 (62.0%)	26 (7.5%)
Profit making	3 (0.9%)	29 (8.3%)	314 (89.5%)	5 (1.4%)

The perception of the interviewed farmers with respect to extent of impacts of the technological use and innovations on their production was revealed on table 20. It was obtained that about 84% cumulatively indicated the impact of the quality of input received through IFAD VCDP programme has highly impacted their production, while about 15% indicated the impact of the quality of input received has been average on their production.

About 80% cumulatively indicated the quantity of input received through the IFAD programmes has highly impacted their production, while about 18% reported the quantity of input received have had an average impact on their production. Not more than 49% cumulatively indicated the standardized production or quality control services received through the IFAD has impacted their productions, while about 45% indicated the quality control services has had an average impact.

Up to 66% of the farmers indicated the extent of the IFAD services on their household income has been high, while about 33% indicated the impact has been rather average. Cumulatively, 44% of the farmers indicated the IFAD services has highly impacted their asset ownership, while up to 47% indicated their asset ownership has only been averagely impacted. Cumulatively, about 31% indicated the IFAD services has impacted their infrastructure management abilities, while up to 43% reported the impact of the services on the infrastructure has been merely average.

With respect to trade promotions, only about 25% altogether, indicated the impact of the IFAD services has been high, while about 43% indicated an average impact, with about 26% indicating a very low impact, and 6% indicating no change in their trade promotions despite the IFAD services. With respect to the farmers' capacity building, cumulatively, up to 70% indicated a high impact of the IFAD services; while about 26% indicated an average impact of the IFAD services on their capacity building. Up to 54% cumulatively indicated they have had a high impact of the IFAD services on their access to innovative platform, while about 25% indicated an average impact, with 20% who indicated a very low impact. Only about 29% jointly indicated a high impact of the IFAD services on their access to market information, while about 41% indicated an average impact on their access to market information, also 19% who indicated a very low impact on their access to market information.

Table 20: Responses on extent of impacts of technological use and innovations

	Very High	High	Average	Very Low	No Change
Quality	56 (15.9%)	242 (68.6%)	53 (15.0%)	2 (0.6%)	-
Quantity	61 (17.5%)	219 (62.9%)	63 (18.1%)	5 (1.4%)	-
Standardized Production (Quality Control)	20 (5.9%)	146 (43.3%)	153 (45.4%)	14 (4.2%)	4 (1.2%)

Household Income	63 (18.2%)	168 (48.4%)	113 (32.6%)	3 (0.9%)	-
Asset ownership	9 (2.6%)	142 (40.9%)	164 (47.3%)	31 (8.9%)	1 (0.3%)
Infrastructure Management	2 (0.6%)	101 (29.7%)	147 (43.2%)	59 (17.4%)	31 (9.1%)
Trade Promotion	6 (1.8%)	76 (22.6%)	146 (43.3%)	89 (26.4%)	20 (5.9%)
Capacity Building	119 (33.9%)	126 (35.9%)	92 (26.2%)	12 (3.4%)	2 (0.6%)
Access to innovative platform	79 (22.7%)	108 (31.0%)	86 (24.7%)	71 (20.4%)	4 (1.1%)
Access to Market information	53 (15.1%)	49 (14.0%)	143 (40.9%)	68 (19.4%)	37 (10.6%)

Source: Field Survey, 2018

The study also sought information from the farmers regarding other farm products they are able to produce during the intervention programmes and the percentage contribution of these extraneous produce to their gross revenue.

The results obtained showed that about 99% of the farmers produce one or more of yam, potatoes and cocoyam alongside their primary farm produce; the least and highest percentage contribution of this farm produce to their gross revenue was 5% and 60% respectively, with an average percentage contribution of 25%.

About 75% of the farmers, who are not primarily cassava producers, indicated they engage in production of cassava; with the least and highest percentage contribution to their gross revenue observed to be 3% and 80%, and an average percentage contribution of 27%.

Approximately 29% of the farmers indicated they also engage in production of Maize; with the minimum and maximum percentage contribution to gross revenue observed to be 2% and 80%, and an average of 22%. About 14%, who are not primarily rice farmers, also indicated to engage in rice

production; with an observed least and highest percentage contribution to gross revenue of 10% and 90% respectively, and average percentage contribution of 41%.

About 11% indicated they also engage in production of other products like Okra, Vegetables, Pepper and Livestock; with the lowest observed percentage contribution of 10% and highest percentage contribution of 50%, and an average percentage contribution of 24%.

Table 21: Analysis of responses on other products produced/sold among farmers and contribution to gross revenue

Produce	**Frequency**	**Percentage Farmers**	**Descriptive Statistics of Percentage Gross Revenue (%)**			
			Min	**Max**	**Average**	**Std. Dev.**
Yam/Potatoes/ Cocoyam	353	99.7	5%	60%	25%	11.17%
Cassava	267	75.4	3%	80%	27%	14.66%
Maize	104	29.4	2%	80%	22%	16.64%
Rice	48	13.6	10%	90%	41%	19.71%
Others(Okra, Vegetables, Pepper, Livestock)	39	11.0	10%	50%	24%	16.85%

Source: Field Survey, 2018.

TECHNOLOGICAL SERVICES AND TECHNOLOGICAL GAPS

This section exposes the responses of the farmers to their use of technologies and innovation services, as well as possible technological gaps observed through the needs and efforts towards technological improvement. Enquiry was made to find out if the farmers' opportunities to inputs, technological and innovations services has increased through the services provided by the IFAD value chain programme. As seen on table 20, up to 93% indicated they had experienced an improved opportunity to improved seed varieties through the IFAD value chain programmes. Only about 38% indicated there had been improvement opportunity for them with respect to their access to tractor services since the inception of the IFAD programme. Not more than 11% indicated they have had an improved opportunity with respect to their irrigation systems. The findings also showed that about 43% indicated they had improved opportunity to post-harvest technologies, such as processing and storage equipment. Only about 38% indicated they have had an improved opportunity with respect to provision of major processing facilities through the IFAD value chain programmes. Up to 61%

indicated they have had an improved opportunity towards marketing technologies. While about 23% indicated they have had improved opportunity to access other technological services through the IFAD programme.

Table 22: Responses on access to inputs, technological innovations and services provided by IFAD

	Improved Opportunities	Equal Opportunities
Improved seed varieties	328 (92.9%)	25 (7.1%)
Tractor Services	134 (38.2%)	217 (61.8%)
Irrigation systems	37 (10.6%)	312 (89.4%)
Post-harvest technologies (Processing and storage)	152 (43.2%)	200 (56.8%)
Provision of processing facilities	131 (38.1%)	213 (61.9%)
Marketing Technologies	214 (61.1%)	136 (38.9%)
Others	52 (22.9%)	175 (77.1%)

Source: Field Survey, 2018

Table 22 below reveals the technological needs stated by the farmers during the research findings. It was observed that the majority of them, amounting to about 51%, expressed their need for provision of equipment, machineries and good roads to enhance their productions. The second most mentioned need was availability of funds, as indicated by approximately 37% of the farmers. About 13% also indicated improved irrigation system as a major need for them, to enhance productions. About 12% expressed their need for availability of improved input. 7% expressed their need for improved agronomic practices. 5% expressed need for each of training/workshop and availability of market/market information. Lastly, not more than 2% expressed their need for availability of extension projects.

Table 23: Responses on Technological Needs Stated by the Farmers

Technological Needs of Farmers	Frequency	Percentage
Provision of equipment, machineries, & good roads	180	50.8
Availability of funds	132	37.3
Improved Irrigation System	46	12.9
Availability of Improved Input	42	11.9
Improved agronomic practices	26	7.3
Training & workshop	19	5.4
Availability of market & market information	19	5.4
Availability of extension projects	6	1.7

Source: Field Survey, 2018.

The table below shows the technological steps taken by the farmers towards improvement of their productions since the commencement of the intervention programme. About 39% indicated they had taken steps to adopt new technologies, innovations, equipment and machines. About 20% indicated they had taken steps to adopt recommended agronomic and production practices. About 17% expressed that they had adopted newly improved variety for their production inputs. About 14% indicated they had been exposed to adoption of newly improved planting techniques, such as line planting, early and timely planting. Not more than 8% indicated they had been exposed to use of fertilizer and other needed chemicals in the right quantity since the intervention programme.

Table 24: Technological steps taken towards improvement of produce and services

Steps Take	Frequency	Percentage
Adoption of new technologies, innovations, equipment and machines	130	39.04
Adoption of recommended agronomic, production practices	68	20.42
Adoption of newly improved variety	57	17.12
Adoption of newly improved planting techniques (Line planting, early and timely planting,	47	14.11

Use of fertilizers, and other needed chemicals, in the right quantity	26	7.81
Others (Training & Product branding)	5	1.50

Source: Field Survey, 2018.

The study also sought to find out the average monthly expenditure pattern among the farmers. A cumulative record of their monthly expenditures on food, gas/kerosene/fuel use, clothing and foot wears, education, electricity, transportation, rent, house needs, and miscellaneous was taken and revealed on table 25. The breakdown of the expenditure by items can be seen on table vii of the Appendix section. It was obtained that, among rice farmers, the minimum and maximum observed monthly spending was 1,600 and 588,000 respectively, with a mean monthly spending of about 72,000. Also, among cassava farmers, the minimum and maximum observed monthly spending was 10,000 and 161,000, with a mean monthly spending of approximately 63,000.

Table 25: Descriptive Statistics on Overall Monthly Expenditure among Rice Farmers and Cassava Farmers

	Min.	Max.	Mean	Std. Dev.
Rice Farmers	1,600	588,000	71,776.0	65,133.6
Cassava Farmers	10,000	161,000	62,676.4	31,956.9

Source: Field Survey, 2018

EMPOWERMENT INDEX OF THE BENEFICIARIES OF IFAD

To determine the empowerment measure of the IFAD programme on the beneficiaries, this section reveals various responses obtained from the farmers that exposes their various farming activities since the inception of the programme. Enquiry was made to find out if the farmers are allowed by the IFAD programme to cultivate other crops during the intervention process, also enquiry was made to find out if they were allowed to make decisions on methods of production or techniques they adopt during the VCDP.

It was observed that about 98% of the farmers who responded to the enquiry indicted they were allowed to grow other type of crops. Also, about 66.3% indicated they were allowed to make

decisions as to the production methods and techniques they adopt, despite the intervention programme.

Table 26: Response on allowance to grow any type of crop during VCDP

	Frequency	**Percentage**
Allowed to grow other crops	301	98.0
Allowed to make decisions	191	66.3

Source: Field Survey, 2018

The farmers were also enquired from as to whether they have been empowered enough to own assets as a result of being beneficiaries of the intervention programmes. About 95% indicated they had been able own assets since they have been benefitting from the intervention programme.

Table 27: Response on ownership of Assets among Farmers

	Frequency	Percentage
Own assets	330	95.4
Do not own assets	16	4.6

Source: Field Survey, 2018.

The study also sought to find out the assets owned by the farmers. It was observed that most of the farmers have been empowered through the intervention programme to own buildings and other constructions, as indicated by about 51%. Up to 46% indicated they had been empowered to own automobiles through the intervention programmes. About 39% indicated they had been empowered to own land. About 25% stated they had owned equipment and machineries for farming, production and processing. Not more than 5% stated they had been empowered to own home materials and utensils.

Table 28: Categories of Assets Owned among Farmers

Assets	**Frequency**	**Percentage**
Buildings & Other Constructions	167	50.61
Automobiles	152	46.06

Land	128	38.79
Farming, Production, Processing equipment and machineries	81	24.55
Home materials & utensils	17	5.15
Others	5	1.52

Source: Field Survey, 2018.

The study also found out the extent to which the farmers have had access to credits from the IFAD programmes, and whether have freedom over the decision they make on credit accessed.

Out of the entire farmers, about 66% indicated they had been able to access credit from the intervention programmes. Among those who have gained access to credit, 86% of them reported they were allowed to take decisions on the credit they have access to.

Table 29: Responses on Access to Credits and Decision on Accessed Credit

	Frequency	Percentage
Have access to credits	232	65.5
Allowed to take decisions on credit accessed	200	86.21

Source: Field Survey, 2018.

Further enquiry to find out the farmers' level of participation in decision making on the use of income from their production within the last 12 months. It was obtained that about 93% among those who responded reported they were allowed to participate in decision making on the use of income made through their farm production. Further enquiry showed that among those who were allowed to participate in the decision making on production income, about 85% stated they participated very well in the decision making on the use of their income; while about 14% indicated they participated fairly well in the decision making on the use of their income; while only 1% indicated their participation was not at all significant.

Table 30: Participation in Decision Making on Use of Income from Production (within last 12 months)

	Frequency	Percentage
Participated in decision making	272	93.2

Very well	232	85.3
Fairly well	37	13.6
Not at all	3	1.1

Source: Field Survey, 2018.

The study found out from the farmers, as seen on table 31, their frequency of visit to farm on daily basis; it was obtained that only about 15% indicated they visit their farms every day, while up to 85% indicated they do not visit farms every day.

Table 31: Frequency of Farm Visitation

	Frequency	**Percentage**
Visit every day	41	15.2
Do not visit every day	228	84.8

Source: Field Survey, 2018.

Information obtained through the research instrument on arrival and departure time on their farms during weekdays and weekends was used in estimating time spent by the farmers on their farm activities separately for weekdays and weekends. It was obtained that the least and highest time spent by the farmers on weekdays is one and half hour and sixteen hours respectively, with an average time of about eight hours. It was also obtained that the least and highest time spent by farmers on weekends on weekends is two hours and about 17 hours, with an average of 8 hours.

Table 32: Responses on Time Spend on Farm Activities on Weekdays and Weekends

	Min.	**Max.**	**Mean**	**Std. Dev.**
Time Spent on Farm Activities (weekdays)	1.5	16.0	7.87	2.08
Time Spent on Farm Activities (weekends)	2.0	16.5	7.89	2.09

Source: Field Survey, 2018.

The farmers' participation in various groups were also enquired on, as seen on table 33. It was observed that only about 39% were participants of an agricultural and livestock group. It was observed that about 11% indicated they were participants of a credit or microfinance group. 9% indicated they were participants in various mutual help or insurance groups. Up to 39% indicated they were participants of different trade and business associations. 83% indicated they were participants in different religious groups. 96% indicated they were participants in the various producers. Only about 10% and 16% reported to be participants of processors and marketers' group.

Table 33: Farmers' Participation in Group Membership

	Yes	**No**
Agricultural & Livestock group	121 (39.5%)	185 (60.5%)
Credit or microfinance group	35 (11.5%)	270 (88.5%)
Mutual help or insurance group	28 (9.2%)	277 (90.8%)
Trade and business association	118 (38.7%)	187 (61.3%)
Religious group	256 (83.4%)	51 (16.6%)
Producers group	293 (95.8%)	13 (4.2%)
Processors group	49 (16.3%)	251 (83.7%)
Marketers group	30 (10.0%)	269 (90.0%)

Source: Field Survey, 2018.

The farmers' level of comfortability and ability to speak publicly towards decision making on infrastructure was enquired on, as seen on table 34. It was obtained that about 48% indicated they

were very comfortable to carry out the activity; about 22% indicated they only feel fairly comfortable; 17% indicated they could carry out the activity but with a great deal of difficulty; 9% indicated they could carry out the activity but with a little difficulty; while about 4% indicated they were not at all comfortable to carry it out.

Table 34: Farmers' Responses on Comfortability on Public Speaking towards Decision Making on Infrastructure

	Frequency	Percentage
Not comfortable	12	4.0
Yes, but with a great deal of difficulty	52	17.4
Yes, but with a little difficulty	27	9.1
Yes, fairly comfortable	65	21.8
Yes, very comfortable	142	47.7

Source: Field Survey, 2018.

The farmers' level of comfortability and ability to speak publicly towards public works and similar progress was enquired on, as seen on table 35. It was obtained that about 44% indicated they were very comfortable to carry out the activity; about 28% indicated they only feel fairly comfortable; 18% indicated they could carry out the activity but with a little difficulty; 9% indicated they could carry out the activity but with a great deal of difficulty; while about 1% indicated they were not at all comfortable to carry it out.

Table 35: Farmers' Responses on Comfortability on Public Speaking towards Public Works & Similar Programs

	Frequency	Percentage
Not comfortable	3	1.0
Yes, but with a great deal of difficulty	27	9.0
Yes, but with a little difficulty	55	18.3
Yes, fairly comfortable	84	28.0
Yes, very comfortable	131	43.7

Source: Field Survey, 2018.

The farmers' level of comfortability and ability to speak publicly towards protest against misbehavior or authorities was enquired on, as seen on table 36. It was obtained that about 52% indicated they were very comfortable to carry out the activity; about 26% indicated they only feel fairly comfortable; 9% indicated they could carry out the activity but with a little difficulty; 10% indicated they could carry out the activity but with a great deal of difficulty; while about 2% indicated they were not at all comfortable to carry it out.

Table 36: Farmers' Responses on Comfortability on Public Speaking towards Protest against Misbehavior or Authorities

	Frequency	**Percentage**
Not comfortable	7	2.3
Yes, but with a great deal of difficulty	29	9.7
Yes, but with a little difficulty	26	8.7
Yes, fairly comfortable	80	26.8
Yes, very comfortable	156	52.3

Source: Field Survey, 2018.

INFLUENCE OF TECHNOLOGICAL INPUTS ACCESSED ON YIELD OF FARMERS

The Pearson Product Moment Correlation showed land cultivated and pesticides/herbicides used have a significant strong positive correlation with production yield; Land cultivated (r = 0.80), Pesticide/Herbicide (r = 0.66). Number of labour used showed a fairly weak correlation with production yield (r = 0.40).

Table 37: Correlation between Yield and Production Input among Rice Farmers

Yield	Correlation (r)	p-value	Remark

Land	0.80	0.00	Significant
Fertilizers	0.19	0.001	Significant
Pesticides/ Herbicides	0.66	0.00	Significant
Labour	0.40	0.00	Significant

Source: Field Surey, 2018.

The simple linear regression was used to check for influence of each input on the production yield among farmers during the intervention programme. It was obtained the multiple correlation coefficient for the model was 0.87, with an r-squared and adjusted r-squared of 0.75 each. Hence, the f-test showed there is a joint significant effect of the input on the production yield of rice farmers (f = 199.95, p = 0.00). The model revealed that land cultivated and hired labour had a significant influence on the production yield of farmers, with p-values 0.00 and 0.01 respectively. Thus, in the absence of other inputs, a unit increase in the hectares of land cultivated adds 3.53 tonnes to the production yield of rice farmers, while a unit increase in the number of human labout hired adds 0.009 tonnes to the production yield of the rice farmers

Table 38: LINEAR REGRESSION MODEL: Yield last year on Input Quantity (Among Rice Farmers)

	Coefficients (β_i)	Std. Error	t-value	p-Value	Remark
Constant	0.37	0.32	1.17	0.25	Not Significant
Cultivated Land	3.53	0.20	17.62	0.00	Significant

Fertilizers used	0.00	0.00	1.08	0.28	Not Significant
Pesticides/Herbicides used	−0.02	0.04	−0.45	0.66	Not Significant
Hired Labour	0.009	0.003	2.60	0.01	Significant

R	R^2	Adj. R^2	F-value	P-value
0.87	0.75	0.75	199.95	0.00

Source: Field Survey, 2018

The Pearson Product Moment Correlation showed land cultivated and pesticides/herbicides used have a significant strong positive correlation with production yield; Land cultivated (r = 0.50), Pesticide/Herbicide (r = 0.66).

Table 39: Correlation between Yield and Production Input among Cassava Farmers

Yield	Correlation (*r*)	p-value	Remark
Land	0.50	0.004	Significant
Fertilizers	−0.04	0.82	Not Significant
Pesticides/ Herbicides	0.66	0.00	Significant
Labour	−0.04	0.82	Not Significant

Source: Field Survey, 2018.

The simple linear regression was used to check for influence of each input on the production yield among farmers during the intervention programme. It was obtained the multiple correlation coefficient for the model was 0.34, with an r-squared and adjusted r-squared of 0.11 and 0.013 respectively. Hence, the f-test showed there is a joint significant effect of the input on the production yield of rice farmers (f = 1.14, p = 0.36).

The model revealed that only pesticides/herbicides used had a significant influence on their production yield last year, at 10% significant level. Thus, in the absence of other inputs, a unit increase in the liters of pesticides/herbicides used increases the production yield of cassava farmers by 2.02 tonnes.

Table 40: LINEAR REGRESSION MODEL: Yield last year on Input Quantity (Among Cassava Farmers)

	Coefficients (β_i)	Std. Error	t-value	p-Value	Remark
Constant	15.29	8.16	1.87	0.069	Significant
Cultivated Land	4.79	5.24	0.91	0.367	Not Significant
Fertilizers used	-0.021	0.02	-1.33	0.191	Not Significant
Pesticides/Herbicides used	2.02	1.13	1.78	0.083	Significant
Hired Labour	-0.11	0.08	-1.44	0.158	Not Significant

R	R^2	Adj. R^2	F-value	P-value
0.34	0.11	0.013	1.14	0.36

Source: Field Survey, 2018.

5.0 CHAPTER FIVE CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The focus of this study is to proof with empirical evidence the impact of innovative technology use of smallholder farmers in Ebonyi State. From the result findings, it can be deduced that the

intervention of the IFAD VCDP is a major breakthrough for improving the productivity of the smallholder farmers and as a consequence their livelihood status. Living standard of the beneficiaries have improved as a result of increased yield, through the acquisition of assets such as furnitures, motorbikes, cars and home-improvement investments. Increase in household cash flows has enabled easy payment of Children's school fees, purchase of preferred materials, payment for other non-farm services and a better participation in community decision making processes. The farmers confessed to the breakthrough they have experienced from low yield and poor productivity as a result of the best practices and innovative technology as brought about by IFAD VCDP.

The Ebonyi State VCDP has recorded some level of successes in the area of innovtions, they have involved farmers and beneficiaries in the introduction and adoption of Dry Season Rice Farming – a production technique that allows farmers to cultivate and produce rice throughout the year even in the off-seasons, this is believed to be helpful to the rural farmers whose major source of livelihood is this. Bird Scaring Equipment has also been introduced and demonstrated to the farmers as a non-expensive way of preventing loss of farm produce to pests and animals. Others include introductions of small machines and equipments for land preparation and irrigation

The project in itself was faced with some short comings as attested to by the respondents. It must be noted that emphasis must be laid also on the level of worsened responses of the beneficiaries of the IFAD VCDP, having the understanding that the purpose of every research is to improve on the existing situations and circumstances.

Operational Challenges

- Some of the beneficiaries lamented on the lack of credit facilities, since IFAD VCDP does not entails giving of loans, although, it could be facilitated but the respondents expressed concerns on the challenges involved in accessing these loans from the financial institutions which they were getting financial assistance which ranges from high interest rate, complex bureaucratic procedures, short repayment duration, credit disbursement un-timeliness, difficulties in getting civil servant as a guarantor and insufficient fund to procure business asset and farm implements. All these factors have taken its toll on the beneficiaries' business asset and profit making. The sustainability of the programme is germane and it can be guaranteed by satisfying the sustainability indicators which are economic, social and

environmental which the IFAD VCDP has delivered to the targeted beneficiaries. Over 68% znd 63% of the total respondents attest to the high improvement they experienced in terms of quality and quantity of their outputs respectively as a result of the innovative technology use being introduced by the IFAD VCDP.

- Farmers' productivity was also threatened by a number of environmental issues. The study found out in the key informant interview and Focus group discussions conducted that a number of respondents were affected by environmental problems such as: flooding, Drought, Crop diseases among others.

- The study also looked at the processing and marketing links also and it was discovered that processing was predominantly manual except for the major Rice mill where almost all the producers carries their product to for processing, most of the respondents do not have the facilities for processing. Also, weak markets linkages to off-takers and financial institutions in the value chain especially in the cassava value chain

- It is to be noted also that many of the inputs that were supplied to the beneficiary most often than not arrive late and requires major push in distribution and follow up and also implementation by the extension agents and Monitoring and Evaluation staffs in ensuring sustainability.

5.2 Recommendation

It is important that market linkage to off takers should be strengthened so as to improve farmers income, the marketing structure in Ebonyi has not been fully implemented and this has a negative effect on the profit of the smallholder farmers. Provison of milling machines to Farmers' groups will not be a bad idea, as it will solve the problem of distance and having to go to the only Rice mills in the state, rubber rolling milling machines can also be provided for clusters, this will surely have a multiplier effect on the productivity and the livelihood status of the beneficiaries.

Land tenure system is also a major challenge that needs to be addressed, reorganization of the land ownership system should be done, intervention by the government can help to achieve this, many of

the farmers showed willingness to cultivate more than their present area of cultivation but were constrained by land availability.

Irrigation systems should be provided for the lowland rice farmers and the arrangement for tractor services begs for a review so as to capture a wholesome amount of the smallholder farmers especially the cassava farmers since this study focuses on how innovative technology has impacted their productivity.

Extension agents and staffs in each of the local government Areas in the state needs to be beefed up so as to reduce the workloads on the existing EAs and also to be able to reach out to the beneficiaries for monitoring and supervision.

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