Dissertation By
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AN ASSESSMENT OF THE EFFECTIVENESS OF THE SUDAN SAVANNA TASKFORCE PROJECT IN THE ADOPTION AND DIFFUSION OF IMPROVED COWPEA VARIETIES IN SELECTED COMMUNITIES IN MUSAWA LOCAL GOVERNMENT AREA, KATSINA STATE

2013

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(M.ED COMMUNITY DEVELOPMENT)

BEING A DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES THROUGH THE DEPARTMENT OF ADULT EDUCATION AND COMMUNITY SERVICES, FACULTY OF EDUCATION, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTERS OF DEGREE IN COMMUNITY DEVELOPMENT OF BAYERO UNIVERSITY KANO

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APPROVAL

This research work has been read and approved as meeting the requirements for the award of Masters of Education (M.Ed) (Community Development) in the Department of Adult Education and Community Services, Faculty of Education, Bayero University, Kano.

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DEDICATION

This dissertation is gracefully dedicated to my late father, Pa Musa Mahayei Mbavai. His greatest joy was to have seen this day, but could not live long enough to harvest the reward. May His gentle soul Rest in Perfect Peace. It is also dedicated to my mother, Yea Hawa Stevens Mbavai, who has missed me so much as I further my education. Finally, to Dr. Alpha Yaya Kamara for his unlimited and untiring efforts to see that the best of me comes out.

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My profound gratitude goes to my lecturers for imparting their knowledge in me and more especially to Dr. A. A. Buchi and Dr. B. Zakari, whose valuable comments made me to understand and have an in-depth knowledge of the true nature of research work. May God bless them all. Also, to Mal. Usman Abba Idris, Mal. Banbangida Ladan and Mal. Auwalu Halilu, all lecturers at the Department of Adult Education and Community Services, Bayero University Kano, for their concern over my work and useful advice I got from them, may God bless them all.

My deepest appreciation goes to my family at school; Mr. Aliyu Kehinde, Mrs. Deborah, Mrs. Gimba and Mr. Stephen whose prayers, contributions, care and friendliness made it possible for me to go through my studies without any stress. God bless them all. Again, my appreciation goes to Miss. Labija Blessing and all staff of Agronomy Unit at the International Institute of Tropical Agriculture, Kano Station whose contributions were in no way small and finally to my Sierra Leonean brothers living here in Kano, Northern Nigeria during my studies, who in one way or the other contributed to the success of this research work most especially Mr. Mohamed Lolleh, Mr. Mohamed Kanu and Mr. Mohamed Jajua for encouraging and being with me throughout the challenging period, May God bless them all

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ACRONYMS AND ABBREVIATIONS

ABU	Ahmadu Bello University
ADB	African Development Bank
ADP	Agricultural Development Programme
AEZ	Agro-ecological zone
AICPVQ	Adoption of Improved Cowpea Varieties Questionnaire
BUK	Bayero University, Kano
CBO	Community Based Organisation (also referred to as local groups)
CIDA	Canadian International Development Agency
CIMMYT	Centro Internacional de Mejoramiento de Maiz yTrigo (International Maize and Wheat Improvement Center)
C-Support	Community-Support
EA	Extension Agent
EAs	Extension Agents
FAO	Food and Agricultural Organisation
FARA	Forum for Agricultural Research in Africa
FGDG	Focus Group Discussion Guide
IAR	Institute for Agricultural Research
IAR4D	Integrated Agricultural research for Development
ICARDA	International Center for Agricultural Research in the Dry Areas
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IP	Innovation Platform
IPs	Innovation Platforms

KKM	Kano, Katsina and Maradi (Pilot Learning Site)
KKM-PLS	Kano-Katsina-Maradi Pilot Learning Site
KNARDA	Kano State Agriculture and Rural Development Authority
KTARDA	Katsina State Agriculture and Rural Development Authority
LG	Local Government
LGA	Local Government Area
NAERLS	National Agricultural Extension and Research Liaison Services
NAPRI	National Animal Production Research Institute
NARS	National Agricultural Research Systems
NGO	Non Government Organisation
NGOs	Non-Governmental Organisations
PLS	Pilot Learning Site
PREA	Participatory research and development approach
PROSAB	Promoting Sustainable Agriculture in Borno
R&D	Research and Development
SS	Sudan Savanna
SSA CP	Sub Saharan Africa Challenge Programme
SSA	Sub-Saharan Africa
SSTF	Sudan Savanna Taskforce
TOT	Transfer of Technology
WOFAN	Women Farmers' Advanced Network

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Abstract

A study was carried out on adoption and diffusion of improved cowpea varieties introduced by the Sudan Savanna Taskforce project in Musawa Local Government Area of Katsina State. The specific objectives were centered on; identifying the socio-economic characteristics of farmers; examining the pattern of adoption of improved cowpea varieties; identifying factors influencing the adoption of improved cowpea varieties and determining problems faced by adopters in cowpea production. To achieve the set objectives, a survey research design was chosen for this study whereby a total of 393 farmers including key informants were randomly selected as sample from 10 communities in the Local Government Area where the project is carrying out its activities. The major instruments used were survey questionnaire and focused group discussion (FGD) for farmers. The data collected were analyzed by using both descriptive and inferential statistics (correlation and regression analyses). Results revealed that majority of the farmers in the study area were male, within an active farming age, and with large household size. Results also revealed that more farmers were aware of improved cowpea varieties compared to the report of the baseline study before the intervention of the Sudan Savanna Taskforce project with an increase in adoption rate. Non-availability of seeds and fertilizer when needed, high cost of fertilizer, pests and diseases were revealed as the major constraints facing farmers in the study area. The study revealed four variables that significantly influence adoption of improved cowpea varieties. These variables include: education of the farmers, contact of farmers to extension agent, participation in extension activities, and membership of association. Similarly, gender, extension contact membership of association, participation in cowpea related extension activities, and livestock rearing were found to have significant influence on the extent of adoption of improved cowpea varieties. The following recommendations were therefore made: Government should encourage young farmers to engage in massive cowpea production across Katsina State by giving them loans and subsidizing farming inputs so as to remove any barrier that will hinder the production of cowpea.; the Sudan Savanna Taskforce project should promote more of the farmers preferred variety; the project should double its efforts in order to increase farmers participation and the number of extension visits in the project area and finally farmers should be sensitized on where to access the improved seeds and fertilizers by also encouraging their participation in community organizations as it is a means of sharing information on improved agricultural technologies among themselves.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture is the most important occupation in Katsina State, Nigeria. The State is predominantly a rural state with approximately 70% of its population, the majority of whom are poor, living in rural areas. According to Kormawa, et al. (2002), Katsina State has a wide ecology divided into three zones for the purpose of agricultural development; Sahel, Sudan Savanna where Musawa Local Government is found and Northern Guinea Savanna. According to Sa'idu (2009), Katsina State faces a lot of challenges with regards to agricultural activities, some of which include among others, desertification, low agricultural productivity, poverty and strange diseases.

Strong agricultural research and development (R&D) is crucial for improving agricultural productivity and efficiency, which in turn will lead to agricultural development, food security, and poverty reduction. In an attempt to address these issues, several efforts have been implemented over the decades to strengthen national agricultural research systems (NARS) in numerous developing countries. According to Byerlee and Echeverria (2002), these efforts have led to a series of reforms, including expansion, contraction, restructuring, downsizing, privatization, and decentralization, though with mixed results. Overall, the capacity of many NARS, especially in sub-Saharan Africa, remains weak.

Many development projects have sought to remove some of these constraints by introducing facilities to provide credit, information, the orderly supply of necessary and complementary inputs, infrastructure investment, marketing networks, etc. Removing these constraints was

expected to result not only in the adoption of the improved practices but also change in crop composition, which was expected to increase average farm incomes even further.

Cowpea (*Vigna unguiculata*), according to Onyibe et al. (2006) is one of the major crops grown in Katsina State. As a legume, it is important for nutrient cycling because of its tolerance to drought and soil acidity as well as its ability to fix nitrogen from the air. It is very well suited to where decline in soil fertility and drought are serious problems. It is a major staple food and cash crop in the State. The seeds are a major source of plant proteins and vitamins for man, feed for animals, and also a source of cash income. According to Bressani (1985), cowpea grain contains about 25% protein and 64% carbohydrate and according to Inaizumi et al. (1999) the crop has a tremendous potential to contribute to the alleviation of malnutrition among resource-poor farmers and to enhance food security and the productivity and sustainability of the crop-livestock system.

According to Dugje et al. (2009), in Nigeria, farmers who cut and store cowpea fodder for sale at the peak of the dry season have been found to increase their annual income by 25% and also plays an important role in providing soil nitrogen to cereal crops such as maize, millet, and sorghum, when grown in rotation, especially in areas where poor soil fertility is a problem.

However, Singh and Tarawali (1997); Inaizumi et al. (1999) and Singh et al. (2002), all reported that despite the potential for further yield increases, cowpea production faces numerous problems including insect pest attack, *Striga gesneroides* parasitism, disease, drought, low and erratic rainfall, and long dry season. As reported by IITA in 2006, every stage in the life cycle of cowpea has at least one major insect pest. According to that report, since cowpea is grown mainly in the dry savanna areas with no irrigation facilities, irregular rainfall especially early in the season have adverse effects on the growth of the crop. All of these factors, singly or

combined, are responsible for the low grain yield, estimated at approximately 350 kg/ha that farmers in Northern Nigeria including Katsina State obtain from their cowpea fields.

The International Institute of Tropical Agriculture (IITA) located in Nigeria, West Africa, which according to Alene and Manyong (2007), has made significant advances in improving the productivity of cowpea, by developing a number of improved varieties and other technologies with generally high grain and fodder yields and resistance to major insects, pests and diseases. Several of these varieties have been released in Nigeria but are not widely disseminated in northern Nigeria including Katsina State. Baseline studies carried out by Ayanwale et al. (2009) shows limited adoption of improved technologies in Katsina State, and about 26% of the sampled farmers in Musawa local government area were aware of improved cowpea varieties but zero percent have adopted citing unavailability of the seeds. According to Tarawali and Kureh (2004), despite the development of a large number of improved cowpea varieties, farmers in northern Nigeria including Katsina State have continued to grow predominantly local varieties. According to Kamara et al. (2009), the limited use of improved varieties in a predominantly cowpea growing region may be due to several factors; lack of information on improved cowpea varieties, unavailability of seed, or the unacceptability of new varieties due to low market values or unsuitability for the farming system.

Over the years, efforts have been made by private, national and international agricultural institutions using various research and extension approaches to promote agricultural activities in Nigeria. Experience with these approaches is based on the fact that they have failed to produce the desired result of increased food production and ensure food security in the country. As explained by Gwary (2008) lack of food self-sufficiency, poverty, malnutrition and hunger are still worrisome trends affecting the Nigerian population. Gwary further stated that the

limitations of the conventional approaches used in Nigeria have been stated by various authors. The major weaknesses of these research and extension strategies identified by Gwary are summarized as follows:

i. Poor and erratic funding especially before and after the World Bank financing of extension projects in Nigeria;
ii. Inadequate research and extension linkage;
iii. Ineffective supervision of extension agents;
iv. High farmer-extension agent ratio, making it difficult for the agent to reach all the farmers effectively;
v. Duplication of organisation and services due to lack coordination of activities between different agricultural and rural development agencies;
vi. Inadequately trained extension agents and irregular on-the-job training;
vii. Poor conditions of service and working conditions for extension staff;
viii. Inadequate number of Subject Matter Specialists (SMSs)

According to Ellis-Jones et al. (2004), most of the conventional approaches to research and development were based on the transfer of technology (TOT) model. Ellis-Jones et al. refer to the TOT approach as an introduction of farming innovations developed outside the target system, sometimes for an altogether different set of circumstances. The underlying concept was that scientific knowledge was superior to farmer's knowledge. Farmers were encouraged through extension workers to adopt the new technologies because the scientists developed them. According to Adekunle et al. (2012), these approaches were better referred to as the linear approach

It was increasingly realized according to World Bank, (2007), that an approach involving many stakeholders was needed to speed the use of knowledge for income generation. This has come be known as an innovation systems approach. The approach embraces the totality of interactions between stakeholders required to encourage the use of research products for innovation that will benefit a wide range of actors.

In 2008, the Sudan Savanna Task Force (SSTF) a sub-project of the Kano-Katsina-Maradi Pilot Learning Site (KKM-PLS) project, which is funded by the Forum for Agricultural Research in Africa, (FARA) and led by the International Institute for Tropical Agriculture (IITA) was set up to operate in four LGAs, Bunkure and Shanono in Kano State, and Musawa and Safana in Katsina State in Nigeria to disseminate improved agricultural technologies. To achieve this and contrary to the linear approach, two innovation platforms (IPs) comprising a coalition of partners and stakeholders have been setup, one in Musawa Local Government Area and another in Safana Local Government Area all in Katsina State by the Sudan Savanna Taskforce to improve agricultural productivity and farmers' incomes. The Sudan Savanna project is particularly concerned with agricultural intensification and integrated natural resource management to improve the rural livelihoods in the Sudan Savanna. The collaborating partners include scientists from the Institute for Agricultural Research (IAR), Samaru, and the KKM Coordinating office in Kano. The taskforce responsible for implementing the sub-project comprises scientists, extension services, NGOs, private sector actors, policymakers (especially at the local level). This group constitutes the nucleus of the innovation platform.

1.2 Statement of the Problem

Though rich in vast arable land, northern Nigeria is faced with many problems that reduce agricultural productivity and keep farmers in poverty. In an effort to mitigate constraints to crop

production in Katsina State, the Sudan Savanna Task Force (SSTF) of the Kano-Katsina-Maradi Pilot Learning Site (KKM-PLS) project, which is funded by the Forum for Agricultural Research in Africa, (FARA) and led by IITA has been set up to disseminate improved agricultural technologies in the State. Among the technologies promoted by the project in Katsina State are improved cowpea varieties. These varieties are of great importance being that they are early maturing, resistance to Striga, insects and diseases, high yielding in both grains and fodders.

To achieve this, two innovation platforms (IPs) comprising a coalition of partners and stakeholders have been setup in each of Musawa and Safanna Local Government Areas of Katsina State by the Sudan Savannah Taskforce to improve agricultural productivity and farmers' incomes. The objective of the Sudan Savannah Taskforce is to use the innovation platforms to enhance agricultural productivity and income of rural farmers along the value chain without degrading the natural resource base. The platforms tackled agricultural production constraints such as drought, Striga parasitism, poor soil fertility, and difficulty faced by farmers in accessing input and output markets.

Since the inception of the FARA-funded Sudan Savanna Task Force project in 2008, it has promoted a number of improved cowpea varieties and management practices among farming households, comprising male and female farmers, in Katsina State. However, no information is available on the state of adoption. Hence, it was pertinent to evaluate the project with respect to adoption of improved cowpea technologies among farming households in the project area. It was therefore necessary to have an understanding of the state of adoption of improved cowpea varieties Katsina State.

This study therefore investigates on the effectiveness of the Sudan Savanna Task Force of the KKM-PLS project in the pattern of farmers' adoption and diffusion of improved cowpea varieties in Musawa LGA in Katsina State.

1.3 Objectives of the Study

The general objective of this study was to examine the effectiveness of the Sudan Savanna Task Force of the KKM-PLS project in the area of adoption and diffusion of improved Cowpea Varieties in Musawa Local Government area of Katsina State.

The specific objectives therefore were to:

i. Identify the socio-economic characteristics of the farmers in Musawa Local Government Area of Katsina State
ii. Examine the pattern of adoption of improved Cowpea varieties in Musawa Local Government Area of Katsina State
iii. Identify the factors influencing the adoption of improved cowpea varieties in Musawa Local Government Area of Katsina State.
iv. Determine problems faced by adopters in Cowpea production in Musawa Local Government Area of Katsina State.

1.4 Research Questions

This study provided possible answers to the following research questions:

i. What are the socio-economic characteristics of the farmers in Musawa Local Government Area of Katsina State?
ii. What is the pattern of adoption of improved cowpea varieties in Musawa Local Government Area of Katsina State?

iii. What are the factors influencing the adoption of improved cowpea varieties in Musawa Local Government Area, Katsina State?

iv. What are the problems that affect Cowpea production among adopters in Musawa Local Government Area of Katsina State?

1.5 Significance of the Study

This study is important because it will better be able to establish more accurately the adoption status of improved cowpea varieties in the project area in Musawa Local Government Area in Katsina State, as well as identify and explain those important factors which promote or hinder effective adoption and diffusion of improved cowpea varieties among the farmers.

By pointing out the factors that influence improved cowpea variety adoption, this study will provide guidance to administrators and researchers for enhancing the program's effectiveness. The added knowledge on which factors have the greatest influence on improve cowpea variety adoption will help administrators make more informed decisions on how to promote the technology.

It is therefore hoped that the findings of this research exercise will form a good reference material for scholars interested in diffusion research, as well as, serve as a guide to extension workers and research institutes involved in cowpea research. The findings of this research will also help the government and projects in planning for effective strategies for increased acceptance and utilization of improved cowpea varieties by cowpea farmers in general.

Most governments and donor agencies are reluctant to fund certain technologies due to lack of enough data that give reasons for such funding. The study will therefore inform government officials and donor agencies to see reasons for providing input materials for farmers to enhance their wellbeing.

1.6 Scope and Delimitation of the Study

The study was focused on factors influencing the adoption and diffusion of improved cowpea technologies, particularly looking at the pattern of adoption, factors influencing adoption and the constraints farmers are facing in cowpea production.

The study was limited in scope, instruments, sample of farmers and study area. It was mainly limited to selected villages in the Sudan Savanna ecological zone of Katsina State because the Sudan Savanna Taskforce project mainly targeted these areas for the production of cowpea. The project area (Musawa) was selected and data collection limited to farmers. Finally, it was limited to a specific period referred to as adoption years.

1.7 Operational definition of terms

Adopter: A farmer who is growing improved cowpea variety/ies

Adoption: Accepting and growing of improved cowpea variety/ies introduced by Sudan Savanna Taskforce of the KKM-PLS project.

Adoption Year: In this study, adoption year covers 2009, 2010 and 2011 planting seasons.

Cowpea: Also known as beans, is an important legume crop in the tropics used as food which contains 25% protein and 64% carbohydrate

Diffusion: The spread of improved cowpea varieties among farmers in Sudan Savanna Taskforce of the KKM-PLS project area.

Dis-adopter: A farmer who used to grow improved cowpea variety/ies but abandoned it for some reasons.

Effectiveness: Means an increase in percentage levels of awareness and adoption of improved cowpea among farmers Musawa Local Government Area.

Improved Agricultural Technologies / Innovations: Farming practices that have been researched on, tried and found to bring about increased crop yield.

Improved Cowpea Varieties: A new type of cowpea that has been introduced by the International Institute of Tropical Agriculture that are early maturing, high yielding and resistance to both striga and drought.

Innovation Platform (IP): This study adopted the definition by Eicher, (2006) who said the (IP) is an institutional arrangement that involves an informal coalition, collaboration, partnership and alliance of public and private scientists, extension workers, farmers' representatives, farmers' associations, private firms, NGOs and government policymakers who cooperate, communicate and interact (often across sectoral and ministerial lines) motivated by common belief that increasing agricultural productivity can help improve welfare of all members of society.

Key Informants: The key informants are the persons who are well-informed and who can verify data and interpret the local terms. They are the people who give basic knowledge about the local inhabitants and can answer the queries. They are middle age persons, who understand the language of people. They know each and everything about village and people are not hesitant in sharing information or problems with them, as they are famous honest people of the Union Council (UC).

Non-Adopter:A farmer who is not growing or has never grown improved cowpea variety/ies

Participatory Research and Extension Approach (PREA): A process that brings farmers, researchers, extension agents, other important stakeholders in farming system like commercial organizations to share ideas in the identification of agricultural problems and putting resources together to overcome those constraints. This process also tries to

enhance adoption of certain management practices by the farmers and to encourage farmers to test several new cowpea varieties under their conditions in a process of varietal selection that would also promote adoption.

Striga: A parasitic weed that reduces yield production of legume crops like cowpea.

Sudan Savanna Task Force (SSTF): The Sudan Savanna Taskforce of the KKM-PLs project was established to build diverse partnerships in innovating platform and disseminate improved crop production practices including crop varieties and crop management practices.

Technology / Innovation: Refer to agricultural practices in the form of materials and ideas.

The Kano-Katsina-Maradi (KKM) Pilot Learning Site (PLS): This is one of the Pilot Learning Sites of the Sub-Saharan Africa Challenge Programme (SSA CP) facilitated by FARA. KKM PLS has 3 Task Forces (TFs) that implement 3 sub-projects (Sahel, the Sudan Savanna and the Northern Guinea Savanna. Each of the three sub-projects aims to evaluate the effectiveness of IAR4D in its respective AEZ by establishing IPs and conducting action research aimed at intensifying crop and livestock systems, improving access to markets and promoting sustainable management of the natural resource base

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter begins with theoretical framework and also examines relevant literature on technology adoption: factors affecting adoption; assessment criteria of an effective project; empirical examples of successful agricultural interventions; and cowpea production and community development.

2.1 Theoretical framework of the study

The theoretical framework for this study is the Innovation-Decision Process theory as popularized by Rogers in 1995. According to Rogers, the innovation-decision process in which a decision-making unit passes from first knowledge of an innovation to the decision to adopt or reject it plays a crucial role for the diffusion of an innovation. In this process five steps are defined: Knowledge, Persuasion, Decision, Implementation and Confirmation.

i. Knowledge occurs when a potential adopter learns about the existence on the innovation and gains some understanding of how it functions. In this stage the individual is first exposed to an innovation but lacks information about the innovation. During this stage of the process the individual has not been inspired to find more information about the innovation

ii. Persuasion occurs when a potential adopter forms a favourable or unfavourable attitude towards an innovation. In this stage the individual is interested in the innovation and actively seeks information/detail about the innovation.

iii. Decision occurs when a potential adopter undertakes activities, which lead to the adoption or rejection of an innovation. In this stage the individual takes the concept of the innovation and weighs the advantages/disadvantages of using the innovation

and decides whether to adopt or reject the innovation. Due to the individualistic nature of this stage, Rogers notes that it is the most difficult stage to acquire empirical.

iv. Implementation occurs when an innovation is actually put to use. In this stage the individual employs the innovation to a varying degree depending on the situation. During this stage the individual determines the usefulness of the innovation and may search for further information about it.

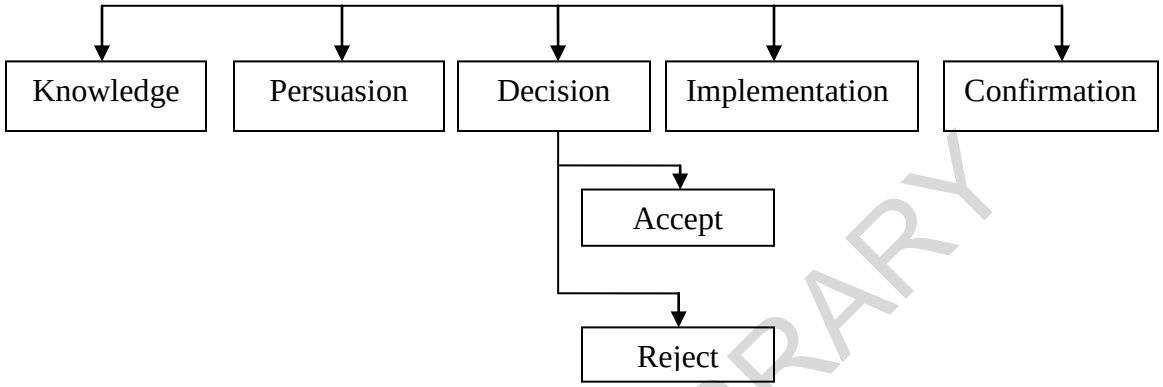
v. Confirmation occurs when an adopter seeks reinforcement of an innovation-decision that has already been made, but the adopter may reverse this previous decision if exposed to conflicting messages about the innovation. Although the name of this stage may be misleading, in this stage the individual finalizes their decision to continue using the innovation and may use the innovation to its fullest potential.

According to Rogers, the first and very important step of the innovation-decision process is that of knowledge. There are three particular types of knowledge: awareness knowledge, how-to-knowledge and principles knowledge. The first of these types, awareness-knowledge is information that an innovation exits. Awareness-knowledge then triggers the potential adopter to seek information of how-to and principles knowledge. This kind of information seeking usually occurs at the knowledge stage of the innovation decision process, but it might appear at the persuasion and decision stages. How-to knowledge is related to information necessary to use an innovation properly. When an inadequate level of how-to knowledge is obtained then rejection and discontinuance are likely to result. Principles-knowledge consists of information regarding the functioning principles underlying how the innovation works. According to Rogers, it is possible to adopt an innovation without principles-knowledge, but the possibility of

misusing the new ideas is greater in that case. The innovation decision process is presented in figure 1.

Innovation – Decision Process theory

Figure 1: Five stages of the adoption process (Rogers, 1962).



The frame work will provide a practical informative insight into understanding the process of adoption of cowpea and the behavior change impact that follows the adoption of the new technology in the study area. Yanguba (2005) pointed out that to improve production level of small-scale farmers they need advice, knowledge and materials that could help improve their welfare. New innovations must therefore reach them in a way that they can use effectively. Innovations must be delivered and allow to be diffused within their socio-cultural and economic settings. In this context diffusion theories such as Rogers' innovation decision process could help to explain how to increase the adoption on innovative products and practices. According to Simtowe et al. (2012), adoption rate could rise up if the entire population is aware or exposed to improved technologies. Kudi et al. (2011) reported that the high rate of adoption of improved maize varieties in Kwara State was as a result of farmers being aware of the varieties.

2.2 The project Sudan Savanna Taskforce and formation of the Innovation Platforms in the project Areas

Over the years, various approaches to agricultural research, extension and rural development have been used in Nigeria. According to Gwary (2008), experience with these approaches is based on the fact that they have failed to produce the desired result of increased food production and ensure food security in the country. Lack of food self-sufficiency, poverty, malnutrition and hunger are still worrisome trends affecting the Nigerian population. Gwary further highlighted some limitations of the conventional approaches used in Nigeria. According to him, the major weaknesses of these research and extension strategies as identified are as follows:

ix. Poor and erratic funding especially before and after the World Bank financing of extension projects in Nigeria;

x. Inadequate research and extension linkage;

xi. Ineffective supervision of extension agents;

xii. High farmer-extension agent ratio, making it difficult for the agent to reach all the farmers effectively;

xiii. Duplication of organisation and services due to lack coordination of activities between different agricultural and rural development agencies;

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altogether different set of circumstances. According to Ellis-Jones et al., the underlying concept was that scientific knowledge was superior to farmer's knowledge. According to Adekunle et al. (2012), farmers were encouraged through extension workers to adopt the new technologies because the scientists developed them.

It was increasingly realized according to World Bank (2007), that an approach involving many stakeholders was needed to speed the use of knowledge for income generation. This has come be known as an innovation systems approach. The innovation systems approach contrary to the linear approach, embraces the totality of interactions between stakeholders required to encourage the use of research products for innovation that will benefit a wide range of actors

In 2008, the Sudan Savanna Task Force (SSTF) a sub-project of the Kano-Katsina-Maradi Pilot Learning Site (KKM-PLS) project, which is funded by the Forum for Agricultural Research in Africa, (FARA) and led by the International Institute for Tropical Agriculture (IITA) was set up to operate in four LGAs, Bunkure and Shanono in Kano State, and Musawa and Safana in Katsina State in Nigeria to disseminate improved agricultural technologies. To achieve this, two innovation platforms (IPs) comprising a coalition of partners and stakeholders have been setup, one in Musawa Local Government Area and another in Safana Local Government Area all in Katsina State by the Sudan Savanna Taskforce to improve agricultural productivity and farmers' incomes.

According to Barnett (2006), the innovations systems approach aims to better integrate the supply 'push' of research and the demand 'pull' of farmers, improving the flow of information between the two by strengthening the capacity of partners to work together in addressing priority constraints. Key to this approach in the Sudan Savanna has had six important elements:

i. The development of strong partnerships to build "innovation platforms" comprised of key stakeholders to address the constraints and needs identified by communities within IP areas. In the SS, this has been led by the International Institute of Tropical Agriculture (IITA) and its partners, who have included the International Livestock Research Institute (ILRI), Ahmadu Bello University (ABU) and the National Agricultural Research Institutions associated with it, the Institute of Agricultural Research (IAR), the National Animal Production Research Institute (NAPRI) and the National Agricultural Extension and Research Liaison Services (NAERLS), Bayero University Kano (BUK), the Kano Agriculture and Rural Development Authority (KNARDA), the Katsina Agriculture and Rural Development Authority (KTARDA) and their respective State Ministries of Agriculture, two NGOs, Women Farmers' Advanced Network (WOFAN) and Community-Support (C-Support).

ii. The addressing of marketing constraints through developing links between farmers and commercial input suppliers, marketing agents and processors (in particular, Jubaili-Agrotec and Grand Cereals, Jos). Seed shortages are being addressed through building links between community-based seed producers and the private seed sector in particular the Seed Project Company.

iii. The establishment of IPs with Local Governments involving policy makers, agricultural executives and traditional leaders. This has been designed to create local ownership and sustainability after project completion.

iv. The use of research knowledge to promote the use and local adaptation of new technologies including improved varieties and new management practices for both crops and livestock. These are being introduced through farmer testing, demonstration and experience sharing in

ways designed to encourage farmer to famer transfer of knowledge. Assessing achievements and sharing lessons is designed to encourage a wider group of stakeholders to adopt similar approaches as a strategy for scaling out project successes to more people.

v. The recognition of the role of farmers, their needs and capabilities as being key to all interventions. Central to this has been the use of participatory research and extension approaches, involving a facilitation process linking researchers, extension agents, farmer groups and commercial stakeholders allowing farmers to prioritize their problems, select and test alternative strategies for overcoming the problems, and importantly learn by doing.

vi. The strengthening of existing and newly formed community based farmers' organisations and groups. This is being undertaken through training of both male and female farmers in organisational development to improve group cohesion, leadership, communication and importantly technical training associated with new technologies.

The objective of the Sudan Savanna Taskforce is to use the Innovation Platforms (IPs) to enhance agricultural productivity and income of rural farmers along the value chain without degrading the natural resource base. According to Ellis-Jones (2009), the platforms tackled agricultural production constraints such as drought, Striga parasitism, poor soil fertility, and difficulty faced by farmers in accessing input and output markets.

2.3 The Participatory Research and Extension Approach (PREA)

The participatory research and Extension Approach (PREA) process is one of the key elements in the implementation of the Sudan Savanna Taskforce project. According to Ellis-Jones et al. (2004), it involves four stages; *community analysis and mobilisation, action planning, implementation and sharing of experiences.* This provides the basis for a period of advocacy to

gain the support of policy makers. The PREA provide not only opportunity for testing and demonstration of new varieties and management practices by farmers, but also research by scientists, allowing farmers to choose the crops and technologies which they wanted to test or produce, reflected the relative importance attached to each crop.

According to Ellis-Jones (2009), the purpose for undertaking community analysis of each project area is to identify major constraints related to each community. Community mobilization activities are to identify farmer groups, lead and seed farmers and agree activities for the coming season. The approach involved training programmes for extension agents (EAs) and farmers selection of technologies for testing and seed types for seed production with the support of KTARDA EAs, followed by evaluations together with the farmers.

In the PREA, people take part in decision making and action collectively. That is, from planning to completion of a shared project. Poverty reduction through participation is considered more equitable, sustainable and effective. When people discuss their problems and try to find its solution through decision making process they feel sense of ownership, commitment and pride (ADB, 2008). According to Usman (2009: 61), the goal of participatory approach is to create awareness among poor and marginalised, and to ensure that the poorest and most vulnerable people would benefit the most from the outcomes of the participatory process.

Usman further explained that the identification of problems and strategies should be made according to determined need. It is also crucial that people should benefit directly to the maximum for the time and energy they invest in the participatory process and not get the treatment of unpaid labourers for agendas laid down by the outsiders.

2.4 Assessment criteria of an Effective Project and Empirical examples of some successful agricultural Interventions

For years, many projects have been established to promote improved agricultural technologies and practices in rural communities. However, CIMMYT (1993); Erenstein (2010) and Rogers (2003), all reported that measuring the adoption and diffusion of agricultural innovations remains a challenging endeavour. Formal adoption and impact assessment surveys have the potential to provide robust indicators. However, rigorous research is needed to assess the effectiveness of such projects.

2.4.1 Assessment Criteria of an Effective Project

The aim of community based agricultural interventions by international development partners is to increase food production through the dissemination of improved crop varieties and other improved agricultural practices. According to Adato and Meinzen-Dick (2002), these interventions have gone beyond just increasing food production to a broader aspect of reducing poverty. This has made both agricultural research and studies of its impact to become more complex. Yet examining the magnitude and mechanisms through which different types of agricultural research are able to help the poor is essential, not only to evaluate claims for continued funding of such research, but more importantly, to guide future research in ways that will make the greatest contribution to poverty reduction.

Effective community based agricultural interventions ensure that the following indicators are in place as stated by Ramírez (2002):

i. Increased access to food and increased income.
ii. Intensification of existing patterns of farm production;

iii. Diversification of production, including increased market orientation and value added post-harvest activities;

iv. Increased operated farm size, either through consolidation of existing holdings or the extension of farming on new agricultural land;

v. Increased off-farm income to supplement farming activities; and

vi. Exit from agriculture, involving migration from rural areas.

Another parameter in measuring effectiveness of agricultural inventions is based on the impact of technologies that are being promoted in rural or target communities and how it has empowered them. This involves the following as stated in La Rovere and Dixon (2001):

i. Better well-being (health, education, etc.), more (cash) income, less vulnerability, more food security, improved asset base (land, labor, livestock), better food security, more physical security, lower farming or climate risk, personal or community empowerment, natural resources preservation, more job opportunities, etc

ii. Household demographics (e.g., labor assets, family composition, and ethnicity).

iii. Social organisation (e.g., inter-household relations, participation in community).

iv. Knowledge, levels of literacy/illiteracy, school drop-out rates.

v. Sanitation and hygiene awareness, health status.

vi. Nutritional indicators (e.g., linked to consumption of nutritionally-enhanced crops).

vii. Number of meals consumed in cropping season and number of months food-insecure.

viii. Ability to borrow money from other households for consumption.

2.4.2 Empirical examples of some successful agricultural Interventions

There are few empirical studies in the literature that specifically assess the impacts of agricultural innovation systems in an African context on the ability of rural people's ability to

better utilize the natural resource base and thus enhance their production increase food security and nutrition and diversify their livelihoods and preserve the ecosystem.

The Food and Agriculture Organization of the United Nations (FAO), (2002) summarized some positive impacts of past interventions:

Agricultural research management has been improved at all levels (policy formulation, planning, organizing, evaluation, and so on) globally.

Strategic planning processes, priority setting, and program budgeting and management are now routinely performed by many NARS; however, the effectiveness of the implementation has not been assessed.

i. Adequate bodies have been established, though their proper functioning is uncertain.
ii. Human resources have improved in quality and quantity, though staff attrition is still very high in many NARS.

In Borno State, Amaza, Abdoulaye, Kwaghe, and Tegbaru (2009) reported that the project Promoting Sustainable Agriculture in Borno State (PROSAB) an IITA project that was funded by Canadian International Development Agency (CIDA) recorded significant achievements in its efforts to improve on the livelihoods of the people of the state. Such successes recorded include among others;

i. Food insecurity has been reduced from 58% in 2004 to 49% in 2008, indicating a 9% improvement in food security over the 4-year period. In addition, a comparison of PROSAB and non-PROSAB communities in 2008 showed that food insecurity is higher (61%) in communities where PROSAB had no interventions compared with 49% in PROSAB communities.

ii. The incidence of poverty in participating communities has decreased from 67% in 2004 to 49% in2008, indicating an 18% reduction in the poverty level among households in the project area. Comparison of household poverty between PROSAB communities and non-participating communities in the State indicate that the incidence of poverty is lower in PROSAB communities by 14%.

iii. The PROSAB project used participatory approach to promote improved varieties of cereals and legumes along with agronomic practices. Training and linking farmers to markets were also important components of this project. Survey results indicate that it has been successful in increasing crop yields in the communities where it worked.

In its report in 2007, the International Center for Agricultural Research in the Dry Areas (ICARDA) whose mission is to contribute to the improvement of livelihoods of the resource-poor in dry areas by enhancing food security and alleviating poverty through research and partnerships to achieve sustainable increases in agricultural productivity and income, while ensuring the efficient and more equitable use and conservation of natural resources, reported on the success of an enhanced appropriate technology packages (improved varieties, proper seeding rates, etc), increased lentil yield (a legume crop grown for its lens-shaped seeds) in Ethiopia and has improved household farmers' income by US$300 per ha for those who adopted the crop which in turn has led to drastic decline in poverty level among adopters of the crop.

2.5 Adoption of agricultural technologies / innovation

Most adoption studies aimed at establishing reasons and factors underlying adoption of improved innovations. As a result, there is an extensive body of literature on the theory of innovation adoption. Bonabana-Wabbi (2002), in her study, pointed out several of such factors that can affect adoption. According to her, they include among others; government policies,

technological change, market forces, environmental concerns, demographic factors, institutional factors and delivery mechanism. Similarly, Abebaw and Belay (2001) documented farmers characteristics, farm characteristics and supply and institutional arrangements, while Adesina et al. (1999) presented socio-economic characteristics of farmers, land tenure rights and village specific characteristics as those factors influencing the adoption of alley farming in West and Central Africa. On this note, Chigona and Licker (2008) said that one of the first steps toward maximizing the rate of adoption of innovations is to understand these factors as they can influence adoption.

2.5.1 Socio-Economic Factors

Socio-economic factors have been reported to significantly influence adoption of agricultural technologies. As reported by the Institute of Agricultural Research (IAR), Nigeria in 2001, women are being prohibited to be directly involved in farming activities in some communities in northern Nigeria because of religious limitations. The report therefore stated that sex composition in cowpea production is very vital as the role of each sex is seen as very crucial to the production of the crop. In her findings, Kamara (2009) reported that male adoption of soybean was higher than that of the female in Borno State. She however stressed the importance of the roles both sexes play in soybean production and again stated that majority of households who adopted the soybean technology were those headed by males. Yanguba (2005) explained that education of household head and farming experience is expected to have a positive effect on adoption of agricultural technologies. Similarly, in a study by Ajayi and Solomon (2010) reported that 26% of females were involved in oil palm production. Coulibaly et al. (2010), stated that women play key roles in agricultural production, but agriculture is increasingly characterized by growing gender imbalances in access to key productive assets such as land,

animal power, and education. The failure of many agricultural research and extension programs in Africa has been argued to be due largely to gender biases in project design and implementation. With the interventions largely inappropriate to them, it is argued that women have been effectively excluded from the development process.

Salasya et al. (2007) reported that educated farmers have a better opportunity to acquire and process information on new technologies. According to Agwu (2000), favourable level of formal education of the farmers would make it easier for extension agents to introduce improved cowpea technologies to them. Ngoc Chi (2008) also mentioned perceptions of technologies, knowledge level of extension staff, methods of organization and management of the extension program and local conditions as the main factors affecting farmers' adoption of technologies. Ngoc Chi further stated factors such as low education, low perception, lack of capital, small land, not good infrastructures and limited capacity of extension staff lead to low technology adoption

The role of a farmer's age in explaining technology adoption has been controversial. Older people are sometimes thought to be less amenable to change and hence reluctant to change their old ways of doing things. In this case, age is expected to have a negative impact on adoption. On the other hand, Muyanga (2009) reported that older people may have higher accumulated capital, more contacts with extension and preferred by credit institutions predisposing them more to technology adoption than younger ones. Bonabana-Wabbi (2002) classified age as the primary latent characteristic in adoption decision. Caswell et al., (2001) and Khanna (2001), reported that farmers perceive that technology development and the subsequent benefits require long duration to realize, can reduce their interest in the new technology because of their advanced age and the possibility of not living long enough to enjoy it. According to studies by

Bamire et al. (2010) and Kolawole (2009), younger farmers are willing to take risk and adopt new technologies.

2.5.2 Institutional Factors

According to Tura et al. (2009), institutional factors and policy variables that include the extent of competitiveness of credit and labor markets, access to extension, the land tenure system, and social prescribed gender roles make up the other set of determinants of adoption and dis-adoption.

The effect of land tenure security is expected to be positive on both technology adoption and continuation. Farmer who does not own land may not be able to capture the full returns from investments in new technology, and thus, will be less willing to use new technology. This is either because they must share the increased product with a landlord or because the expected flow of returns exceeds their period of secure tenure. Inadequate infrastructure like roads and lack of seed are other external factors affecting technology adoption and dis-adoption. Households living near major towns have good access to both physical infrastructure and seed supplies hence are expected to be using previously adopted technologies.

Oladele (2005) explained that since prices of seed and fertilizer are the major cost components of production, a rise in input, coupled with other constraints, may render farm activities unprofitable which is in line with disenchantment theory of dis-adoption. According to Coulibaly et al. (2010), the profitability of the cowpea cropping systems depends mainly on the types of varieties used (local or improved), the cropping practices and management (use of chemicals including fertilizers and pesticides), and the access to input and output markets.

Another major factor that farmers in Central-Western Ethiopia as mentioned by Tura et al. (2009) which serves as a constraint to the adoption of hybrid seed is lack of credit. This is

because according to them, farmers have found it increasingly difficult to get credit from official sources.

As revealed by Adedipe (2012), in her study, she reported that farmers who Participated in cowpea related activities was not in vain as the income they generated from the sales of cowpea, they were able to meet certain needs that are associated with improved standard of living such as food, clothing, shelter, education, healthcare and recreation. Unlike the non participants she said that are more of subsistent farmers than the participants. Farmer's participation has been an important factor in extension programmes. Farmers' involvement in cowpea related activities in the study area was a bit low. There is need to increase their involvement. Agwu et al. (2008) also found that membership to association positively and significantly influenced adoption of improved technologies. Studies by Odoemenem (2007); Agwu (2000); Bamire et al. (2010) and Odoemenem and Obinne (2010), all reported that membership of association enhances access to information on improved technologies, material inputs of the technologies (fertilizers and chemicals) and credit for the purchase of inputs and pay for farm labour. Also, membership of farmer/social organization is considered an important variable that enhances farmers' adoption of new practices due to group dynamic effects and that membership of association positively and significantly influenced adoption of improved technologies.

Onu (2006) found that farmers who had access to extension adopted improved farming technologies had 72% productivity growth rate than those who had no access to extension services. The utilization of new technologies is often influenced by farmers' contact with extension services, as they provide technical advice for increase in agricultural production. Adoption level increases with the intensity of extension services offered to farmers. According to Owens et al. (2001) and Doss et al. (2002), extension contact is clearly the variable that is

most highly correlated with the use of improved technologies and that regular contact with extension raises improved cowpea production by an average of 18.5% and 15% but the contact has no significant effect on cowpea production under traditional technology.

2.5.3 Technology Related factors

Many research works have been done on the influence of technology characteristics on the rate of adoption. Yanguba (2005; 44), said that a farmer adopts a new technology as a result of its relative utility. In his study, the utility of technologies was assumed to be determined by four major types of technology characteristics including profitability, initial cost, risk and complexity. Meaning, the more a technology profits farmers, the higher the demand for adoption if the cost of that technology is within their income. Adesina and Zinnah (1993), show that technology characteristic determines its diffusion. Farmers' perceptions on the post harvest qualities of the improved cowpea variety namely: threshing quality and boiling quality are important in seed diffusion process. According to Kormawa, Ezedinma and Singh (2004), programs promoting farmer-to-farmer seed diffusion should ensure that crop varieties disseminated have acceptable post harvest technology attributes. As reported by Ali-Olubandwa et al. (2010) that adoption of improved maize practices by farmers resulted in increased production and that small scale farmers were able to adopt these practices because they were easy to adopt and that farmers from Lugari District realized high maize yields in Western Province as compared to the other study districts.

2.6 Cowpea Production and Community Development

Katsina State is predominantly a rural state with approximately 70% of its population, the majority of whom are poor. According to Bandabla (2005: 14), to be poor is to be hungry, to lack shelter and clothing, to be sick and not cared for, to be illiterate and not educated. Poor

people are particularly vulnerable to adverse events outside their control. Bandabla further stated that the poor are often treated badly by institutions of state and society and are excluded from having a say or power in those institution. Rural poverty is a serious threat to food and nutrition security in Sub-Saharan Africa (SSA) and specifically in Nigeria. There is therefore the urgent need to mitigate the problem of poverty in rural area, whose economic livelihood is directly dependent on land exploitation. Unfortunately, over half of Africa's rural poor are located on "low potential" and "fragile" lands. Other contributors to rural poverty in Nigeria according to Bandabla are agricultural and economic policies of previous governments, which negatively affect farming communities. Of the many technology-related constraints of farmers, only a fraction can be addressed effectively through agricultural research. Worse still, most resource-poor farmers are unable to formally articulate their technology needs.

According to FAO (2006) report, rural and agricultural development and equitable distribution of the benefits of economic growth are crucial for the global reduction of poverty and hunger. Numerous studies have provided evidence that the impact of economic growth on reducing hunger and poverty depends as much on the nature of the growth (e.g. industrial or rural economy based) as on its scale and speed. For example, a World Bank analysis of data from India, found that growth in rural areas and in the agriculture sector had a much greater impact on reducing poverty than did urban and industrial growth.

There is need to increase agricultural production in order to provide sufficient food for an expanding population. According to Pretty and Hine (2001) "A rural household needs the following to be food secure:

i. An adequate supply of food, either grown on the farm or bought with earned income, and measured in kcal or kg of cereal equivalent;

ii. A variety of food containing the necessary mix of protein, carbohydrate and fat, together with vitamins and mineral, for a healthy diet;

iii. The appropriate quantity and diversity of food throughout the year, particularly during months of shortage and/or insecurity."

According to Langyintuo, et al**. (**2003) cowpea therefore is the most economically important indigenous African legume crop. Hall (2007) reported that in the Sahel, flowering, drought-adapted varieties of cowpea have become an important famine food, producing significant grain in dry years when all other crops fail to produce grain. According to Hall, these early cowpea varieties are important for supplying food and cash during the hungry period just prior to the main harvests of staple food crops and that the harvest and sale of fresh cowpeas during the hungry period is mainly done by women because it benefits them the most. Coulibaly et al. (2010), explained cowpea is a low cost nutritious food that does not require refrigeration. It fits the condition of the urban poor. It is a versatile African crop: it feeds people, their livestock and the next crop, and is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready. It is a crop that offers farmers great flexibility.

According to Davis et al. (2009), cowpea has many uses, in fresh form, the young leaves, immature pods and peas are used as vegetables, while several snacks and main meal dishes are prepared from the grain. All parts of the plant that are used for food are nutritious, providing protein, vitamins (notably vitamin B) and minerals, green cowpea seeds are boiled as a fresh vegetable or may be combined or frozen and the dry mature seeds are also suitable for boiling and canning.

Dry grain and fodder according to Mahalakshmi (2004), are two most important yield components of cowpea. According to Moalafi, Asiwe and Funnah (2010), cowpea is a staple

food in many regions of Africa. Its desirability reflects the fact that the leaves, immature pods, fresh seeds (southern pea or "green pods"), and the dry grain are popularly eaten or marketed. According to Singh et al. (2003), some varieties have a short cycle and mature early and thus are able to provide food during the hungry period, usually at the end of the wet season when food availability can become extremely scarce in semi arid regions of Sub-Saharan Africa.

2.7 Summary of Literature Review and Uniqueness of the study

From the preceding discussions, and review of literature, the theoretical framework reveals that potential adopters of an innovation must have background information of that innovation. This enables them to weigh both the negative and positive effects of such innovations. From the literature, it is also clear that adopting such innovations or technologies depend on several factors which help to explain the pattern and level of adoption. However, an attempt to include all these factors in a model is generally not a viable option. Also, strong correlation generally exists among a number of these factors, preventing their inclusion in modeling efforts. Considering this limitation, therefore, those factors hypothesized to exert the largest influence on technology adoption, given the circumstances in the study area, were investigated and analysed. As mentioned earlier, they include, socio-economic factors, institutional factors, technology related characteristics and information delivery mechanisms. These factors may lead to either adoption or disadoption of improved cowpea varieties.

This study is unique in the sense that other studies like Yanguba (2005) focused mainly on improved maize by looking at adoption and impact in Katsina, while Kamara (2009) focused mainly on improved soybean by looking at adoption and Gender differences in Borno. This study focused on improved cowpea by bringing out information on the level and pattern of adoption as well as factors influencing adoption of improved cowpea varieties in cereal-based

production systems in Katsina State. No such studies have ever been carried out in the State after a major intervention to address production and marketing constraints of cowpea from 2008. The information provided by this study can help the designers of the KKM-PLS program as well as policy makers in the State and the country at large to design programs that would enhance rapid adoption and diffusion of agricultural technologies in Nigeria.

CHAPTER THREE

METHODOLOGY

This chapter is focused on the research design of the study, population, sample and sampling procedure, research instrument, data collection procedure and methods of data analysis.

3.1 Research Design

To have an in-depth knowledge on the state of adoption and measure the effectiveness of the Sudan Savanna Taskforce of the KKM-PLS project, this study adopted a survey research design. The survey research design clearly shows the trends of cowpea production in the study area based on which a standard questionnaire was developed. Survey research design can also help in seeking opinions, views, perspectives, and perceptions of people on effectiveness of the Sudan Savanna Taskforce project in the adoption and diffusion of improved cowpea varieties. It is efficient in the sense that it can handle many respondents in the quickest possible time and at a very low cost.

3.2 Population, Sample and Sampling Procedure

3.2.1 Population

The population for this study targeted all male and female small scale farmers drawn from ten (10) communities in Musawa Local Government Area (Musawa LGA), estimated to be 21,800 farmers, (Sudan Savanna Taskforce, 2009) to assess the Sudan Savanna Taskforce Project.

3.2.2 Sample Size

The sample size for this study was determined based on Yamane (1967) sample size determination procedure (see Appendix III figure 3). Using this procedure, a total of 393 farmers was selected from the total population. The sample size was made up of:

i. Lead and seed farmers who were given improved cowpea seeds directly by Sudan

Savanna Taskforce, participated in training, field days and demonstrations (participants or direct beneficiaries).

ii. Other farmers who did participate in training, field days, demonstrations who were not given improved cowpea seeds by IITA (non-participants or indirect beneficiaries). The identification of such farmers (participants / direct beneficiaries and non-participants / indirect beneficiaries) was to measure farmer-to-farmer diffusion of improved cowpea varieties in the study area and;

iii. Key informants chosen from among the farmers for the purpose of Focus Group Discussions (FGD) (See definition of terms).

Figure 2: Farming population drawn from ten (10) communities in Musawa LGA

S/No	Community	Population	Sample Farmers
1	Bakam	2000	39
2	Dankado	2000	39
3	Farin Dutse	2000	39
4	Garu	3000	48
5	Gingin	1500	25
6	Kurkujan	1800	35
7	Rugar Fari	2000	39
8	Tarbbani	1500	25
9	Tuge	4000	65
10	Yarkanya	2000	39
TOTAL		**21800**	**393**

Source: *Sudan Savanna Taskforce Community Mobilization list (2009)*

3.2.3 Sampling Procedure

A two-stage sampling techniques was carried out in order to select the sample respondents. The first stage was a purposive selection of the project communities (where the project has been working to promote improved cowpea technologies). The second stage was also the selection of respondents with the help of Sudan Savanna Taskforce project staff using list of farmers in the project area. A simple random sampling technique was used to select a total number of three

hundred and ninety-three (393) farmers as sample for the survey. Out of this number, 300 respondents were selected for the administration of the survey questionnaire and 93 respondents for the purpose of FGD.

3.3 Instruments for Data Collection

A survey questionnaire and Focus Group Discussion Guide were chosen for the collection of information from the farmers for this study in order to achieve the study objectives.

3.3.1 Adoption of Improved Cowpea Varieties Questionnaire (AICPVQ)

This questionnaire was adapted from earlier similar studies on maize and soybean crops by Yanguba (2005) and Kamara (2009) respectively. This study preferred questionnaire because of the ease of administration and scoring, besides the results being readily analyzed. The items on the questionnaire were developed on the basis of the objectives of the study which was divided into:

(a) Socio-economic characteristics of the farmers

(b) Cowpea Production, Adoption and Pattern

(c) Factors Influencing Adoption and Challenges.

For the household questionnaire, (See appendix I)

3.3.2 Focus Group Discussion Guide (FGD)

The Focus Group Discussions were conducted in the selected study communities with the help of extension agents from the Katsina State ADPs in Musawa Local Government to backstop findings from the survey questionnaire. Each group discussion session was organized around guided topics. The discussions were recorded on the discussion guide by the researcher himself ticking and writing where applicable. It has four major components:

- Reasons for growing improved cowpea varieties

- Constraints encountered in growing cowpea
- Cowpea varietal selection base on characteristics in ranking order
- Benefit of working with the Sudan Savanna Taskforce project.

The Focus Group Discussion Guide, (See appendix II).

3.4 Validation of Instruments

3.4.1 Validity

The questionnaire was tested in order to validate its content, construct and face validity. Content validity ensured that the content of the instrument contained adequate sample of the domain of content it represented. Face validity looked at the format of the instrument that includes aspects like clarity of printing, font size and type, adequacy of workspace, and appropriateness of language among others. Construct validity determined the nature of psychological construct or characteristics being measured by the instrument. The research supervisor and two other experts in measurement and evaluation from Bayero University, Kano were also consulted to help in the review to ensure the instrument accurately measured the variables it intended to measure in the study. A community extension expert was also consulted to further validate the content of the instruments.

3.4.2 Reliability

To ensure the reliability of the instrument, the test-retest method was employed. Through the test-retest method, this instrument was administered on a pilot sample of an interval of two weeks between first and second administration. Correlation analysis was conducted to ascertain the reliability index of the two tests. The result of the analysis indicated a reliability index of .76. This is substantial to attest that the instrument was reliable.

3.5 Data Collection Procedure

The instrument was administered to the farmers by the researcher himself alongside five (5) trained enumerators (Extension Agents). An appointment for administration of questionnaires to the respondents was booked with the assistance of the Sudan Savanna project staff, extension agents and the village headmen. The instrument was administered to farmers by enumerators to collect the required information and their responses recorded accordingly. The study focused mainly on household heads for the survey questionnaire to cater for uniformity of data collection process.

3.6 Methods of Data Analysis

The data collected was entered and analyzed by simple descriptive analysis and econometric models using Statistical Package for Social Scientists (SPSS) version 16 software. The software was chosen because it is the most used package for analyzing survey data. The software has the following advantages: it is user friendly, can easily be used to analyze multi-response questions, cross section and time series analysis and cross tabulation; (i.e. relate two sets of variables) and it can also be used alongside Microsoft excel and word. The descriptive statistics involving the use of frequencies and the measures of central tendency was used to summarize the data. The probit and tobit models were used to study the decision-making behavior of farmers in the study area to determine the factors influencing adoption of the improved cowpea varieties and to model the probability of adoption and disadoption, and the choice of any of these models according to Adesina and Chianu (2002), depends on the issue of interest.

Using the Probit Model for this study, adoption was treated as different variable; the variable was valued “1” if the household had adopted the new technology (ies), and valued “0” if they had never planted the improved cowpea varieties. Both probit and tobit models were techniques

used for estimating the probability of an event such as adoption that can take one of two values (adopt, don't adopt). According to CIMMYT report in 1993 the models use a series of characteristics of the farm or farmer which may be dichotomous or continuous variables to predict the probability of adoption.

The choice and specification of econometric models used in analyzing the factors that influence farmer's adoption decision varies. According to Adesina and Chianu (2002), sometimes the choice depends on the issue of interest. This study was designed to measure the pattern and factors influencing adoption of improved cowpea varieties by farmers in the Sudan Savanna Taskforce project communities in Katsina State, and to identify the effect of variables on farmers' adoption decision. In addition to the Probit Model, which was used to determine initial adoption decision of improved cowpea varieties by farmers in the study area, the Tobit Model (Tobin, 1958) was also used to measure both probability and extent of adoption or intensity of use of the improved cowpea varieties after initial decision to adopt. This model is preferred for this study in order to achieve its objectives. Studies, including those of Adesina and Zinnah (1993); Ramasamy et al. (1998) and Shiyani et al. (2002) have all used the Tobit model in measuring the extent of farmer's adoption decision.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

The results of this study using methods, instruments and analytical models recommended are presented and discussed in this chapter. The interpretation are based on the set objectives and research questions set out in chapter one. Findings were also explained in the context of related studies and reviewed literature.

4.1 Research question one

What are the socio-economic characteristics of the farmers in Musawa Local Government Area of Katsina State?

One of the major concerns of this study was to identify the socio-economic characteristics of the farmers on the adoption of improved cowpea technologies. Past studies IAR (2001); Yanguba (2005); Muyanga (2009); Bonanaba-Wabi (2002); Caswell et al. (2001); Khanna (2001) and Tura et al. (2009) have all shown that most household socio-economic characteristics influence farmers decision to adopt or not to adopt improved agricultural technologies. Data and results for research question one are presented in tables 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8 and 4.9.

4.1.1 Gender of the farmers

Table 4.1: Percentage distribution of farmers by gender

Gender	Frequency	% of respondents (n = 300)
Male	273	91.0
Female	27	9.0
Total	**300**	**100.0**

Source: Field survey (2011)

Results

Survey responses were obtained from 300 respondents across 10 communities consisting of extremely more men (91.0%) than women 9.0% as presented in Table 4.1.

4.1.2 Age of the farmers

Table 4.2: Percentage Distribution of Respondents according to Age of the farmers

Age Range	Frequency	% of respondents (n = 300)
15-24years	14	4.7
25-34years	82	27.3
35-44years	84	28.0
45-54years	66	22.0
55-64years	39	13.0
65years and above	15	5.0
Total	**300**	**100.0**

Source: Field survey (2011)

Results

Age has been found to determine how active and productive the head of the household would be. As shown in Table 4.2 above, majority of the respondents (27.3%), (28.0%) and (22.0) were within the age range of 25-34, 35-44 and 45-54 years respectively. These altogether represent 77.3% of the entire sample population.

4.1.3 Marital status

Table 4.3: Percentage distribution of household heads by marital status

Marital Status	Frequency	% of respondents (n = 300)
Single	21	7.0
Monogamously married	121	40.3
Polygamous married	156	52.0
Widowed	2	.7
Total	**300**	**100.0**

Source: Field survey (2011)

Results

Table 4.3 indicated that most of the respondents were married with 40.3% in monogamous marriage and 52% in polygamous marriage with only a small proportion (7.0%) being single.

4.1.4 Education

Table 4.4: Percentage distribution of Educational level of farmers

Education Level	Frequency	% of respondents (n = 300)
No formal	5	1.7
Primary	71	23.7
Secondary	52	17.3
post secondary/tertiary	27	9.0
Koranic	139	46.3
Others	6	2.0
Total	**300**	**100**

Source: Field survey (2011)

Results

The educational status of the farmers in the study area is presented in table 4.4. Results show that 23.7%, 17.3% and 9.0% of the farmers had primary, secondary and post secondary/tertiary education respectively.

4.1.5 Household Size, Farming experience and Cowpea growing experience

Table 4.5: Distribution of farmers according to Household Size, years of Farming Experience and years of growing Cowpea

	Household size	Farming Experience	Cowpea Experience
Mean	10.67	21.66	15.83
Std. Deviation	6.470	13.396	11.606
Minimum	1	1	1
Maximum	34	70	60

Source: Field survey (2011)

Results

In this study, the household was defined as a domestic, residential, production, consumption and reproduction unit. As shown in Table 4.5, the average household size was 10.67 persons per household. The farming experience of the respondents in the study area as presented in Table 4.5 varied widely, with a minimum of only one year and a maximum of 70 years. The average farming experience however was 21.66 years.

With respect to number of years the respondents have been growing cowpea it is evident from entries in Table 4.5 that the number of years ranges from one to sixty years with an average of 15.83 years.

4.1.6 Membership of Association

Table 4.6: Distribution of farmers according to membership of farmers' Association

Membership of Association	**Frequency**	**% of respondents (n = 300)**
Yes	169	56.3
No	131	43.7
Total	**300**	**100.0**
Type of Association		**% of respondents (n = 164)**
Community Development	68	41.5
Farmers Association	82	50.0
Cooperative	4	2.4
Religious Association	3	1.8
Workers Union	4	2.4
Traders Union	2	1.2
Others	1	.6
Total	**164**	**100.0**

Source: Field survey (2011)

Results

Results from Table 4.6 showed that, majority (56.3%) of the respondents belonged to associations. From those who belonged to associations, 50.0% and 41.5% belonged to farmers and community development associations respectively.

4.1.7 Non-agricultural / Off-farm activities

Table 4.7: Distribution of Respondents according to whether or not they engage in non-agricultural activities and types of non-agricultural activities.

Non-Agric. Activities	Frequency	% of respondents (n = 300)
Yes	240	80.0
No	60	20.0
Total	**100**	**100.0**
Type of Non-Agric. Activities		**% of respondents (n = 236)**
Trading/Hawking Wares	145	61.4
Artisan/Craftsman	63	26.7
Hunting/Fishing	3	1.3
Civil Service	25	10.6
Total	**236**	**100.0**

Source: Field survey (2011)

Results

Table 4.7 above shows that 80.0% of the respondents were engaged in other activities other than farming. Out of this, majority 61.4% were engaged in trading/hawking, 26.7% artisans and 10.6% were civil servants. Very few (1.3%) were engaged in hunting/fishing.

4.1.8 Extension Contact among participants and Non-participants

Table 4.8: Percentage distribution of respondents according to contact with extension services by participation

Extension Contact	Frequency	Total (%) (N = 300)
Yes	168	56.0
No	132	34.0
Total	**300**	**100.0**
Extension Structure		**(n = 162)**
NGO	5	3.1
Researcher/IITA	127	78.4
ADP/KTARDA	30	18.5
Usefulness (n = 152)		
Useful	77	50.7

Source: Field survey (2011)

Results

The over-all extension contact among the farmers was 56.0% as shown in table 4.8. Most of the contacts were made with researchers from the Sudan Savanna Taskforce project with a percentage of 78.4%, while 18.5% and 3.1% contacts were made with National Research Institution (ADP/KTARDA) and NGO respectively. On the usefulness of extension contact, the over-all percentage of farmers who regarded extension contact as useful was 50.7%.

4.1.9 Participation in cowpea related activities

Table 4.9: Percentage distribution of number of farmers interviewed by participation

Participation	Frequency	% of respondents (n = 300)
No	198	66.0
Yes	102	34.0
Total	**300**	**100.0**

Source: Field survey (2011)

Results

Table 4.9 shows that 34% of farmers participated in cowpea related extension activities like; field days, demonstrations, trainings and workshops organized by the Sudan Savanna Taskforce project

4.2 Research question two:

What are the patterns of adoption of improved cowpea varieties in Musawa Local Government Area of Katsina State?

In order to answer the research question two, five key indicators were employed to determine pattern of adoption. First is the awareness level of farmers and their sources of information, second is the adoption level, third is the adoption in relation to some variables such as gender,

participation, extension contact, age and location of the farmers. The data and results are presented in tables 4.10, 4.11, 4.12, 4.13 and 4.14.

4.2.1 Awareness and source of information

Table 4.10: Percentage distribution of respondents according to Awareness of Improved Cowpea Variety/ies and sources of information in the study area.

Variables	Frequency	Percentage (%) of Respondents (N = 300)
Awareness		
Aware	198	66.0
Not aware	102	34.0
Total	**300**	**100**
Source of information (N=198)		
Radio	11	3.7
Extension agent	124	41.3
Neighbor	9	3.0
Market	13	4.3
Village or Community organization	41	13.7
Total	**198**	**100**

Source: Field survey (2011)

Results

As shown in table 4.10, 66.0% of the farmers were aware of improved cowpea varieties. Most of them got the information from extension agents (41.3%) and Village or Community organizations (13.7%).

4.2.2 Adoption by gender, participation and extension contact

Table 4.11: Percentage distribution of Adopters of General Cowpea versus Improved Cowpea variety by gender, participation and extension contact.

Variable	Grow cowpea	Grow improved cowpea
Gender		
Male	90.3 (271)	30.7(92)
Female	9.0(27)	5.0(15)
Total	**99.3**(298)	**35.7**(107)
Participation		
Participant	34.0(102)	28.0(84)
Non-participant	65.3(196)	7.7(23)
Total	**99.3**(298)	**35.7**(107)
Extension Contact		
Yes	56.0(168)	32.0(96)
No	43.3(130)	3.7(11)
Total	**99.3**(298)	**35.7**(107)

Source: Field survey (2011), ( )=Frequency

Results

Table 4.11 shows that, almost all the farmers (99.3%) were growing cowpea. This is represented by 90.3% male and 9.0% female farmers. The results further revealed that 35.7% of the farmers grew improved cowpea varieties. The pattern of adoption further showed that 30.7% were male farmers while 5.0% were female farmers. Furthermore, 28.0% of those who adopted were participants and 7.7% were non-participants. Also, 32.0% of those who adopted had extension contacts and 3.7% did not have any extension contact.

4.2.3 Adoption by Age Range

Table 4.12: Percentage distribution of respondents according to Age Range

Age Range of Respondents (N = 107)	Frequency	Percentage (%) of Respondents
15-24years	4	1.2
25-34years	26	8.7
35-44years	38	12.7
45-54years	23	7.7
55-64years	11	3.7
65years and above	5	1.7

Source: Field survey (2011)

Results

Table 4.12 shows that those who adopted improved cowpea varieties were within the ages of 25-54 year (29.1%), with most within 35-44 years.

4.2.4 Adoption of Improved cowpea varieties

Table 4.13: Percentage distribution of adoption of improved cowpea varieties, year and source of seeds

	Varieties			
	IT97K-499-35	**IT98K-205-8**	**IT98K-573-1-1**	**IT89-288**
Year of Adoption	**(%) N = 47**	**(%) N= 25**	**(%) N = 12**	**(%) N = 29**
2009	55.3(26)	48.0(12)	33.3(6)	51.5(17)
2010	36.2(17)	32.0(8)	27 .8(5)	24.2(8)
2011	6.4(3)	20.0(5)	11.1(2)	12.1(4)
Seed Origin	**(%) N = 46**	**(%) N= 24**	**(%) N = 17**	**(%) N = 33**
SSTF/IITA	85.1(40)	95.8(23)	52.9(9)	60.6(20)
KTARDA/ADP	0(0)	0(0)	0(0)	6.1(2)
Market retailer	2.1(1)	0(0)	0(0)	0(0)
EAs	2.1(1)	4.2(1)	17.6(3)	18.2(6)
Friends/relatives	6.4(3)	0(0)	23.5(4)	15.2(5)
Other farmers	2.1(1)	0(0)	5.9(1)	0(0)

Source: Field survey (2011), ( ) = Frequency

Results

Table 4.13 shows adoption pattern of four different improved cowpea varieties. In 2009, the adoption rate of the different varieties include; 55.3% (IT97K-499-35), 51.5% (IT89-288), 48.0% (IT98K-205-8) and 33.3% (IT98K-573-1-1). In 2010, the adoption rate was 36.2% (IT97K-499-35) 24.2% (IT89-288), 32.0% (IT98K-205-8) and 27.8% (IT98K-573-1-1). In 2011, adoption rate was 6.4% (IT97K-499-35), 12.1% (IT89-288), 20.0% (IT98K-205-8) and 11.1% (IT98K-573-1-1). This indicates that there was general decline in the adoption across the improved varieties with years. Reason for this was due to non-availability of improved seeds. Major source of improved cowpea seeds as stated in the table was the Sudan Savanna Taskforce project with 85.1% (IT97K-499-35), 60.6% (IT89-288), 95.8% (IT98K-205-8) and 52.9% (IT98K-573-1-1). This suggests that the project has a crucial role to play if farmers are to have access to improved seeds in the survey area. Another source of improved seeds mentioned was friends/relatives with 6.4% (IT97K-499-35), 15.2% (IT89-288), 0.0% (IT98K-205-8) and 23.5% (IT98K-573-1-1) indicating therefore that there was farmer to farmer transfer of seeds aside the project being the major source.

4.2.5 Adoption by Location

Table 4.14: Percentage distribution of adopters of improved cowpea variety by Location

Village / Community	Frequency	Percentage (%) of Respondents N=300
Bakam	15	5
Gingin	9	3
Tarbbani	6	2
Yarkanya	18	6
Dan kado	10	3.3
Rugar	9	3
Farin Dutse	9	3
Garu	13	4.3
Kurkujan	6	2
Tuje	12	4
Total	**107**	**35.7**

Source: Field survey (2011)

Results

Table 4.14 shows the adoption level disaggregated by community. As presented in the table, 6.0% of the farmers in Yarkanya adopted improved cowpea, 5% in Bakam, 4.3% in Garu, 4.0% in Tuje, 3.3% in Dan Kado, 3.0% in Gingin, 3.0% in Rugar Farin, 3.0% in Farin Dutse, 2.0% in Kurkujan and 2.0% in Tarbani.

4.3 Research question three

What are the factors influencing the adoption of improved cowpea varieties in Musawa Local Government Area, Katsina State?

In this study three key factors were identified as having influence on adoption of improved cowpea varieties. These are technology related factor, benefits as a result of the sale of cowpea and land ownership. Data and results in relation to research question three are presented in tables 4.15, 4.16 and 4.17 respectively. In addition, the probit and tobit model results are also discussed in 4.3.4 to further show which factor has the most significant influence.

4.3.1 Technology related characteristics

Table 4.15: Percentage distribution of respondent according to technology related characteristics as reasons why farmers grow improved varieties.

Variables	Frequency	Percentage of (%) n=300
Is it high yield	269	89.7
High income/profit from market sales	284	94.7
Resistance to drought	169	56.3
Early maturity	217	72.3
Household food security	185	61.7
Diversified food products from cowpea	196	65.3

Source: Field survey (2011)

Results

Table 4.15 shows the desired characteristics of improved cowpea varieties given farmers in the study area. The farmers gave high income (94.7%), high yield (89.7%), resistance to drought (56.3%), early maturing (72.3), household food security (61.7) and diversified food products from cowpea (65.3%) as reasons why they grow improved cowpea.

4.3.2 Benefits as a result of sale of cowpea

Table 4.16: Percentage distribution of respondents according to benefits farmers derived from the sale of cowpea

Benefits	Frequency	Percentage (%)
Paying school fees for children	244	81.3
Buy clothing for self and family members	273	91.0
Pay for medical facilities	258	86.0

Source: Field survey (2011)

Results

As shown in Table 4.16, other benefits derived from cowpea production as a result of high income gained from the sale of cowpea pointed were buying of clothing for self and family members received the highest percentage (91.0%), followed by payment for medical facilities (86.0%) and paying school fees for children (81.3%).

4.3.3 Land Ownership

Table 4.17: Percentage distribution of respondents according to method of land acquisition and ownership in the study area

Type of Ownership of farm Land	Frequency	%
Inherited	228	76.0
Bought/owned	51	17.1
Borrowed	11	3.5
Family owned	7	2.4

Source: Field survey (2011)

Results

Land ownership is sometimes a factor to agricultural technology adoption. In the study area, 76.0% of the farmers interviewed inherited their lands while 17.1% bought their own (Table 4.17). This suggests that farmers have more access to land. From past studies, it has been revealed that lack of access to land has negative effect on technology adoption.

4.3.4 Estimation of some determinant factors of adoption of improved cowpea varieties

In an attempt to identify factors influencing adoption of improved cowpea varieties in the study area, the probit regression model was used to further identify the probability to which these factors positively and significantly influence adoption. Using the model, four major variables significantly affected adoption of improved cowpea varieties at 10% significant level (see appendix III); these variables include: education of the farmers (P<10%), contact of farmers to extension agent (P<1%), participation in extension activities (P<1%), and membership of association (P<10%).

Similarly, the tobit regression model was used to further measure the extent of adoption of improved cowpea varieties. The model shows the extent to which the adopting farmers increased the land area under cultivation of improved cowpea. The result revealed that five variables: gender, extension contact membership of association, participation in cowpea related extension activities, and livestock rearing all have significant influence on the extent of adoption of improved cowpea varieties (see appendix IV).

4.4 Research question four

What problems affect Cowpea production among adopters in Musawa Local Government Area of Katsina State?

Data and results in relation to research question four is presented in table 4.18.

4.4.1 Constraints to Cowpea Production

Table 4.18: Major problems / Constraints to Cowpea Production

Problems / Constraints	Frequency	%
Non-availability of seeds when needed	204	68.0
Non-availability of fertilizer	163	54.3
High cost of fertilizer	178	59.3
Diseases	211	70.3
Pests	238	79.3

Source: Field survey (2011)

Results

The major constraints to the adoption of improved cowpea varieties were: non-availability of seeds when needed (68.0%), non-availability of fertilizer (54.3%), high cost of fertilizer (59.3%), diseases (70.3%) and pests (79.3%) as presented in table 4.18. Non-availability of improved seed was the third major constraint which singly can lead to low adoption rate in the study area.

4.5 Summary of major Findings

The major findings of the research were summarized as follows:

i. The dominant Socio-economic characteristics of farmers in the target project community shows mainly male, married with more wives, within active working age, with little formal

education mainly Koranic, were found to be active members of farmer association, with large household size and have great farming experience.

ii. The pattern of adoption of improved cowpea varieties indicate a great influence of extension workers with majority of adopters cultivating IT98K-205-8 because of high yielding, high income from sale of the crop, early maturing, drought tolerant / resistant and its capacity to contribute to food security as well as its value chains.

iii. The factors influencing adoption are mainly education of the farmer, farmers contact with extension agents, participation in cowpea related activities, membership of association, gender and livestock ownership.

iv. The major challenges faced by farmers include; non-availability of improved cowpea seeds when needed in the community on large scale**,** non-availability / high cost of fertilizer, diseases and pests.

4.6 Discussion of Findings

The study revealed that most of the farmers were male (91%) compared to female farmers (9%). IAR (2001); Yanguba (2005); Muyanga 2009; Bonabana-Wabbi (2002); Caswell et al. (2001); and Tura et al (2009) all agreed to the fact that men are more empowered to own land and that cultural and religious factors only allow women to be involved in crop processing into end products like food and market sales. The farmers in the study area fall between age bracket of 25 and 54 years. This means that there were more young people involved in farming in this area. This may increase production of improved cowpea because young people are energetic enough to engage in farming and are ready to take the risk trying any new technology being introduced. Majority 56.3% of the farmers belonged to various associations. This means that there was dissemination of information regarding improved agricultural practices in the study

area. The average household size was 10.67 meaning households have more mouths to feed which calls for more involvement in farming activities for food production.

The study revealed that in adoption process, awareness is generally perceived as a first step. No farmer adopts a particular technology without being aware or first hearing about it. This confirms Rogers' 1995 Innovation-Decision Process Theory of adoption and diffusion of innovations. Rogers opined that a potential adopter learns about the existence of innovation and gain some understanding of how it functions. The gap between the awareness rate and adoption as revealed by the study agrees with Rogers that most of the farmers are still to take decisions probably due to issues surrounding improved cowpea varieties; like the non-availability of the seeds. Therefore, some are still using their traditional / local varieties. As revealed by the study, the major players in creating awareness about the existence of the improved crops are the extension agents who act as major driving force behind improved cowpea adoption. They play crucial roles in adoption process as they are very close to the farmers by giving them first hand information on improved varieties and others improved agricultural practices. The increase in awareness after three years maybe due to the efforts of the project to create awareness through field days, radio programs, field demonstrations and training of farmers. These findings are consistent with report from Simtowe et al. (2012), who reported that improved pigeon pea adoption rates in Kenya could have risen up if the entire population was aware or exposed to the improved pigeon pea varieties. It is also consistent with report from Kudi et al. (2011) who also revealed that all the farmers in their study area in Kwara State were aware of the improved maize varieties which led to high adoption. Furthermore, Inaizumi et al. (1999) reported rise in rates of adoption among farmers cultivating dry-season dual-purpose cowpea in 1997 in the semi-arid zone of Nigeria. They reported that only 4 years after the introduction of the first

variety by one farmer in the semi-arid zone, the adoption rates were very impressive. They gave a percentage figure of 75% adoption of dry-season dual-purpose cowpea varieties. More male farmers adopted improved varieties than female farmers probably due to the low number of women involved in cowpea production. In this study more young farmers adopted cowpea more than the old ones. This may be that young farmers are eager and ready to take risk in trying any new technology introduced to them. Again they have more energy and strength to do more physical work. This finding agreed with findings of Bonabana-Wabbi (2002) who classified age as the primary latent characteristic in adoption decision. As Caswell et al., (2001) and Khanna (2001) reported that farmers perceive technology development and its subsequent benefits as a long process to realize. This can therefore reduce their interest in any new technology because of their advanced age and the possibility of not living long enough to enjoy it. As revealed by the study, four (4) different types of improved cowpea varieties were introduced in the study area at the time of intervention. The adoption of these varieties introduced in the study was not uniform. Though they all share similar characteristics, but some were more preferred. The most adopted variety in 2009 was IT97K-499-35, but became the least adopted in 2011. The most adopted variety among the four in 2011 was IT98K-205-8. Most reasons responsible for this mentioned was the non-availability of seeds when needed and insect pests attack. The progressive reduction in adoption with years may be due to lack of seed since cowpea seed multiplication rate is low and cowpea is subject to pest attack even in the store (A.Y. Kamara, personal communication). Adoption rate among the ten communities were almost uniform except for Yarkanya and Bakam that were slightly above the other communities. Improved cowpea varieties were introduced in these communities at the same time. As mentioned earlier, major reason responsible for the low rate was due to non-availability of seeds when needed. The

study revealed that cowpea is a major crop grown in the study area as almost all the farmers are growing the crop. But it was not so for improved cowpea varieties. Although Ayanwale, et al. (2009) reported that there was only 26% of awareness of improved cowpea varieties in the study area with zero percent adoption in the baseline study, the current study showed an improvement in awareness (66.0%) and adoption (35.7%) of improved varieties. This suggests that the project made progress in creating awareness and adoption of improved cowpea varieties. Further, adoption of improved cowpea varieties resulted in some other positive effects as farmers cited several reasons why they adopted improved cowpea varieties. These were high income they derived from the sale of the crop, the crop's high yielding quality, potential of the crop to provide more food in the farmers' households to feed their families, early maturing, the crop's potential of being processed into diversified food products and the crop's drought resistance quality. Coulibaly et al. (2010), explained that low adoption of improved varieties is argued to be one of the reasons for low yields. Even when a farmer is said to have adopted an improved variety, it is usually the case that the seeds have been recycled for many generations to the extent that their yields advantage have been lost and hence give no more yields than the local varieties. Also, that most improved varieties lack the characteristics valued by farmers. This has in turn been due to the failure of crop improvement programs to involve farmers in the process of designing and developing improved varieties with a view to meeting their priorities and preferences. It is therefore important that Breeders look for these traits (high yielding, earliness, marketability and drought resistant) while breeding seeds for farmers. According to Kamara et al. (2009), they reported that although new varieties have potential roles where they offer advantages over local varieties, they are unlikely to replace local varieties which combine many farmer-preferred characteristics. It is therefore essential that researchers (Breeders) in

developing new varieties are aware of the wide range of criteria or local preferences in the production and utilization of cowpea and, if possible, build these traits into new germplasm which fits local farming systems. It was also revealed by the study that improved cowpea varieties can lead to food security by providing food at the peak of hunger period when food is mostly needed and the crop has the quality to be produced twice in the year making it to be known as a dual-season crop. This study is therefore in agreement with findings of Yanguba (2005) who reported that the more a technology profits farmers, the higher the demand for adoption. The study also agrees with study by Ali-Olubandwa et al. (2010) who reported that adoption of improved maize practices by farmers resulted in increased production and that small scale farmers were able to adopt these practices because they were easy to adopt and that farmers from Lugari District realized high maize yields in Western Province in Kenya as compared to the other study districts in the country. This study has reaffirmed the report by Pretty and Hine (2001), who stated that a rural household needs the following to be food secure: adequate food supply, variety of food containing mix of protein and fat and appropriate quantity and diversity of food throughout the year, particularly during months of shortage. These qualities have been found in cowpea by this current study. This study revealed that income gained from the sale of cowpea according to the farmers was used for the upkeep of their families like buying of clothing for every member of the household, settling of medical bills and payment of school fees. From this, it can be explained that most farmers do not rely on free education before sending their children to schools as they can afford the school fees. It can therefore be concluded here that empowering farmers to increase on their crop production can lead to the achievement of the Universal Basic Education (UBE) as one of the millennium development goals (MDGs). This also applies to the aspect of primary health care, because most

farmers can afford medical bills. So empowering farmers is of paramount importance towards the achievement of the MDGs. This is supported by most responses from participants in the FGDs who even brought forward their children to be seen how robust they looked. Their only plea was they wanted to expand their production areas but were limited by non availability of adequate seed.

The results of the tobit model showed that gender had significant influence on the probability of adoption of improved cowpea varieties at 1% (see appendix IV). This is due to the fact that male farmers are the ones owing lands, cash and have the potential to borrow money for crop production. This report therefore agreed with findings of IAR (2001) and Yanguba (2005). In both reports, they found that women are being prohibited to be directly involved in farming activities in some communities in Northern Nigeria because of religious and cultural limitations. The findings of the current study also agreed with studies by Kamara (2008) in Borno State". She reported that male adoption was higher than that of female in the state. Similarly, this result is in agreement with study of Ajayi and Solomon (2010) who reported that only 26% of females were involved in oil palm production in Delta State, Nigeria. Coulibaly et al. (2010), also stated that women play key roles in agricultural production, but agriculture is increasingly characterized by growing gender imbalances in access to key productive assets such as land, animal power, and education. The failure of many agricultural research and extension programs in Africa has been argued to be due largely to gender biases in project design and implementation. With the interventions largely inappropriate to them, it is argued that women have been effectively excluded from the development process. During the Focus Group Discussions across the study communities, male farmers were the main participants as women are not much considered in decisions relating to farming. There is therefore need to encourage

and assist women farmers to be actively involved in farming activities as the global trend for development is gearing towards agriculture. The role of women in agriculture is no way insignificant. They should be encouraged to participate actively in farming activities especially cowpea production because of the nutritional value attached to the crop. As revealed by this study, majority of the farmers interviewed were middle age farmers. According to this study, age is not a significant factor to adoption of improved cowpea varieties. Furthermore, there is a negative correlation between farmer's age and adoption of improved cowpea (See appendix IV). Nonetheless, there is relatively high proportion of middle aged able-bodied farmers in the study area. This is based on the fact that young and middle age farmers have more energy and eagerness to accept and adopt new farming techniques and technologies. They also have access to productive land in most cases. This finding agreed with Bonabana-Wabbi (2002) who classified age as the primary latent characteristic in adoption decision. Studies by Caswell et al. (2001) and Khanna (2001) found that technological development and its subsequent benefits requires long duration to realize and therefore reduces the interest of farmers that are advanced in age because of the possibility of not living long enough to enjoy or realize the benefits. In the same vein, studies by Bamire et al (2010) and Kolawole (2009) all agreed that younger farmers are willing to take risk and adopt new technologies. According to Bamire et al., farmers in the Savannas of Borno State, Nigeria were within the productive and active age bracket of 25-60 years suggesting their readiness to take risk and adopt innovations. Education as revealed by the study, proved to be a significant factor influencing probability and extent of adoption of improved cowpea varieties (see appendix III and IV). The result showed that most of the farmers have acquired some form of formal education. The study therefore agreed with study by Agwu (2000). According to the report, education has been shown to be a factor in the adoption

of yield-increasing modern farm practices and that favourable level of formal education of the farmers would make it easier for extension agents to introduce improved cowpea technologies to them. As reported by Alene and Manyong (2007), farmer education has significant and positive effects on improved cowpea, as opposed to traditional cowpea production. According to that report, four years of education raises cowpea production under improved technology by 25.6%, but it has no significant effect on traditional cowpea production. Alene and Manyong further concluded that farmer education has a higher payoff for farmers cultivating improved varieties and applying a package of new inputs than for farmers using largely traditional technology. Alene and Manyong further stated that when the production technology is traditional, it can be formalized and passed on from generation to generation by example, and formal education may have little or no contribution. Under improved technology, however, coping with the instability induced by technological change in agriculture requires new knowledge and skills, and better-educated farmers are likely to adjust more successfully than less educated farmers. Salasya et al. (2007) reported that educated farmers have a better opportunity to acquire and process information on new technologies. Membership of association had a significant influence on both probability and extent of improved cowpea adoption (see appendix III and IV). This implies that farmers were able to exchange ideas among themselves. As further revealed by the study, those who were members of associations adopted the technology more than those who were not. This is in support of study reported by Odoemenem (2007) stating that membership of association enhances access to information on improved technologies, material inputs of the technologies (fertilizers and chemicals) and credit for the purchase of inputs and pay for farm labour. Since a large number (56.3%) of farmers belonged to one organization or the other, the possibility of sharing knowledge among them concerning

improved or new farm practices and new agricultural products is inevitable. According to report by Agwu (2000), membership of farmer/social organization is considered an important variable that enhances farmers' adoption of new practices due to group dynamic effects. Baseline study in the project area reported by Ayanwale et al. (2009) revealed membership of the farmer organization was 20% all put together. Tura et al (2010), reported that membership to cooperative were found to be important in Ethiopia. Studies by Bamire et al. (2010), Odoemenem and Obinne (2010), Agwu et al. (2008) all reported that membership of association positively and significantly influenced adoption of improved technologies. The result shows that extension contacts had a significant influence on the probability and extent of adoption of improved cowpea varieties (see Appendix III and IV). Contact with extension agent is a major factor determining the level of adoption of agricultural innovation. There is therefore need to strengthen extension institutions by national and international research institutions. Many studies have supported that extension contact is very important. Chikaire et al. (2011), reported that the goals of extension includes, transferring knowledge from researchers to farmers; advising farmers on their decision making; educating farmers to be able to make similar decision in future and enabling farmers to clarify their own goals and possibilities to enhance desirable agricultural development. This finding is in agreement with findings of Onu (2006) who reported that farmers who had access to extension adopted improved farming technologies had 72% productivity growth rate than those who had no access to extension services. The utilization of new technologies is often influenced by farmers' contact with extension services, as they provide technical advice for increase in agricultural production. Adoption level increases with the intensity of extension services offered to farmers. This is in agreement with Odoemenem and Obinne (2010), who pointed out that constant meeting / frequency of

extension contact between the extension personnel and farmers would enlighten them and create better awareness for the potential gains of improved agricultural innovations. This result is also in agreement with findings of Doss et al. (2002) who reported that extension contact is clearly the variable that is most highly correlated with the use of improved technologies. The result again agreed with findings of Alene and Manyong (2007) and Owens et al. (2001) who reported that regular contact with extension raises improved cowpea production by an average of 18.5% and 15% but the contact has no significant effect on cowpea production under traditional technology. This confirms the greater role of extension services in raising the yields of improved varieties through the provision of adequate and timely advice on improved technological packages. The most significant factor that had influence on both the probability and extent of adoption of improved cowpea varieties was farmers' participation in cowpea related activities organized by the Sudan Savanna Taskforce project. These activities include among others: on-farm trials, field demonstrations and training relating to cowpea production (see appendix III and IV). Improved cowpea varieties are largely new technologies in the study area. Farmers attach greater risk to new varieties than their traditional or local varieties. Therefore adoption of new technologies can be enhanced through farmers who have first-hand experience with the new technologies. To increase the rate of adoption among farmers, they have to be encouraged to participate in activities relating to new farm practices like; on-farm trials and demonstrations and training related to such technologies as in the case of improved cowpea introduced in the study area. In similar recent study by Adedipe (2012), she reported that farmers who participated in cowpea related activities benefitted from the activities by using the income they generated from the sales of cowpea to meet certain needs that are associated with improved standard of living such as food, clothing, shelter, education, healthcare and

recreation. Unlike the non participants she reported that they were more of subsistent farmers. Farmer's participation has been an important factor in extension programmes. Farmers' involvement in cowpea related activities in the study area was a bit low. There is need to increase their involvement. The result agrees with the findings of Apantaku et al. (2002) who reported on small-scale farmers' involvement in agricultural problem identification and prioritization in Yewa North LGA of Ogun State Nigeria as low. The implication of the findings is that farmers should be actively involved in the analysis of their situation which forms the basis for identifying their immediate needs and constraints for appropriate interventions. Through participation, farmers are exposed to new farming techniques to improve on their production yields to enhance better standard of living.

The result of the study also revealed a positive relationship between livestock keeping and cowpea production and has significant influence on the extent of adoption of improved cowpea (see appendix IV). Livestock rearing and cowpea production complements each other. This result is therefore in agreement with a study conducted by Inaizumi et al. (1999) who reported that livestock rearing is very important in the semiarid region of Nigeria and the production of cowpea fodder is a significant source of income and in addition to the obvious economic benefits is the value of cattle droppings in the field. Inaizumi et al. further reported that this system contributes to the sustainability of mixed crop/livestock farming systems in the semiarid region. According to the report, adoption of dry season dual-purpose cowpea has helped to improve farmer/cattle herders' social interactions that contribute to the sustainability of the system through effective crop/ livestock integration. Manure from livestock is returned to the field, and animals provide milk, meat, income, and traction for land preparation, weeding, and transport. This implies that the more livestock the farmers keep, the more they increase the

level of adoption. This support the fact that cowpea is a major source of animal feeds. The household is size was found to be not significant to adoption of improved cowpea but has a positive correlation (See appendix IV). This is not unexpected as Islamic religion which is a common practice in the study area allows for the marriage of up to four wives. Moreover, in traditional society, it is believed that children are not only security but source of labour on the farm thereby reducing labour cost required in cowpea production.

Farming experience is expected to be an important factor determining both productivity and production levels in farming. According to Amaza et al. (2007), the effect of farming experience on adoption maybe positive or negative. Farmers in the study area had considerable number of years of farming experience that might have impact on the attitude to change in farming practices. The experience they have in growing cowpea entails accumulation of indigenous knowledge, experience of which if tapped can represent an asset in improved cowpea production. This study did not however, find it as a significant factor. The study revealed that farmers had access to land but most of the lands were inherited with only few who bought theirs. This can have a positive or negative effect because it was expected that access to land leads to adoption and increase production. One of the reasons behind adoption is farmers' access to land. As revealed by this study, almost all the farmers have access to land (70.0%) inheritance and (17.1%) bought/owned. It is expected that farmers who have access to land have no fear taking up risk to invest on them. The only encouragement they may need is to invest in the buying of inputs that will allow them cultivate the lands on a large scale. However these assumptions are not as real as proposed. A study by Ali-Olubandwa et al. (2010) reported a high number of farmers in Lugari District adopting all the improved agricultural practices passed to them, because farmers in Lugari District were commercial minded. This was

attributed to the fact that the farmers had initially bought the lands, and therefore desired to make maximum profit from the land, as opposed to farmers from the other districts who had inherited small land parcels which were always used for subsistence farming.

Across the survey communities, it is clear that non-availability of seeds, disease and insect pests attack were among the major constraints facing farmers in cowpea production. These reasons are mostly responsible for abandoning or why farmer are not growing improved cowpea varieties. In the focused group discussions in each of the communities, these constraints were the main points of discussions. Many farmers participated in the discussions as a medium of venting out their frustrations towards cowpea production. Some said they want to cultivate the crop but they do not have access to the seeds. To some, the discussion groups were meant for the distribution of cowpea seeds, but were disappointed when they learnt that it was information gathering forum. The study is in agreement with the findings of Singh and Tarawali, (1997); Inaizumi et al., (1999); Singh et al. (2002) and IITA (2006). They all reported that despite the potential for further yield increases, cowpea production faces numerous problems including insect pest attack, *Striga gesneroides* parasitism, disease, drought, low and erratic rainfall, and long dry season. According to these reports, every stage in the life cycle of cowpea has at least one major insect pest. Since cowpea is grown mainly in the dry savanna areas with no irrigation facilities, irregular rainfall especially early in the season have adverse effects on the growth of the crop. All of these factors, singly or combined, are responsible for the low grain yield, estimated at approximately 350 kg/ha that farmers in Northern Nigeria including Katsina State obtain from their cowpea fields. As reported by Oladele (2005), that since prices of seed and fertilizer are the major cost components of production, a rise in input, coupled with other constraints, may render farm activities unprofitable which is in line with disenchantment theory

of dis-adoption. According to Coulibaly et al. (2010), the profitability of the cowpea cropping systems depends mainly on the types of varieties used (local or improved), the cropping practices and management (use of chemicals including fertilizers and pesticides), and the access to input and output markets.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The major components of this chapter include summary of the study, conclusion and recommendations.

5.1 Summary

The purpose of this study was to assess the adoption and diffusion of improved cowpea varieties in Musa LGA that were promoted by the Sudan Savanna Task Force of the KKM-PLS project after three years of project implementation. The study also undertook an empirical analysis of the factors influencing the adoption of improved cowpea varieties in the project area. The specific objectives were centered on; identifying the socio-economic characteristics of farmers; examining the pattern of adoption of improved cowpea varieties; identifying factors influencing the adoption of improved cowpea varieties and finally determining problems faced by adopters in cowpea production in Musawa Local Government Area of Katsina State.

To achieve the set objectives, a survey research design was chosen for this study whereby a total of 393 farmers including key informants were selected as sample from 10 communities in the Local Government where the project is carrying out its activities. The major instruments used were survey questionnaire and focused group discussion (FGD).

Data were analyzed using both descriptive (frequencies, percentages, mean, minimax, maximax and standard deviation) and inferential statistics (correlation and regression analyses). Inferential statistics was used to ensure which factor has strong influence on adoption.

Results of the study showed that majority of the respondents were male farmers within the age bracket of 25-54 years. Few farmers had formal education with an average household size of 10.67, and a mean farming experience of 21 years. More than half (56.3%) of the respondents

belong to various organizations. Majority of the farmers earn extra income outside farming. More than half (56.0) of the farmers had extension contacts. Very few (34.0%) of the farmers participated in cowpea related activities organized by the Sudan Savanna Taskforce project.

Results of the study revealed that almost all the farmers (99.3%) in the study area were growing cowpea generally. Only 66.0% were aware of improved cowpea varieties and only 35.7% had adopted the improved cowpea varieties. Among the farmers that adopted the improved varieties, majority were those who had extension contacts, those who had participated in cowpea related activities promoted by the Sudan savanna Taskforce project and those within the age bracket of 25-54 years. Four varieties of improved cowpea varieties were introduced in the project area by the Sudan Savanna Taskforce project. Among the four varieties the most adopted variety in 2009 was IT97K-499-35, but was the least adopted in 2011. The most adopted variety in 2011 was IT98K-205-8. Yarkanya and Bakam were the two communities that adopted improved cowpea varieties the most with the least being Tarbbani.

Among the technology related characteristics that were given as reasons for adoption of improved cowpea varieties include: high yielding, high income leading to payment of school fees, payment of medical bills and buying of clothing, early maturing, drought tolerance, household food security and diversified food products. Among the socio-economic characteristics discussed as factors influencing adoption of improved cowpea varieties, education of the farmer, extension contact, participation in cowpea related activities, membership to association and livestock keeping were the factors strongly associated with improved cowpea adoption.

Major constraints revealed were: non-availability of improved seeds, non-availability of fertilizer, high cost of fertilizer, diseases and pests.

5.2 Conclusion

Based on the major findings of the study, the following conclusions are drawn:

This study revealed that majority of the farmers in the project area were male farmers, within the age gap of 25-54 years, married with more than one wife and few had received formal education. The results revealed that 95% of cowpea farmers in the study area are men. The study revealed that the average house size in the study area was 10.67, suggesting that households are larger which is a problem to food security The people in the project community have been farming for quite a good number of years and have good number of years cultivating cowpea and almost all the farmers in this area plant cowpea (local or improved). Awareness and adoption rates of improved cowpea varieties were the basis for assessing the effectiveness of Sudan Savanna Taskforce project. Compared to the baseline report by Ayanwale et al. (2009), where they reported that only 26% of the farmers were aware of improved cowpea varieties with zero percent adoption of these varieties in Musawa LGA, this study has revealed that awareness from that time has increased to 66.0% in just three years. Adoption rate has grown from zero percent to 35.7%. This suggests a tremendous achievement in just three years. The major source of information came from extension agents. This shows the importance of strengthening extension institutions in the State since they are very vital to training of farmers in the use of improved cowpea production technologies. . This study therefore agreed with findings of Yanguba (2005), who reported that extension agents play crucial roles in creating awareness and disseminating agricultural technologies.

However, the disparity between awareness level and adoption rate was due to some factors that includes; non-availability of seeds when needed, non-availability and high cost of fertilizer,

pests and diseases. These were the focal points of the Focused Group Discussions (FGDs) in all the communities visited. During the group discussions, all the respondents mentioned the above constraints for slow adoption of improved cowpeas in the LGA.

Cowpea seed production is a difficult process and is very low in the communities. There is little or no difference between cowpea seed and grain because the two carry the same price tag in the market. Also, cowpea is a cash crop and very expensive in the market. Farmers do not wait for planting seasons before selling their seeds. Further, as a result of this, seed companies do not go into seed production because cowpea seed and grain are treated as one (Kamara, A. Y. personal communication). Another reason for non-availability of seed was that of insect pests attack during storage. This makes farmers not to store their seeds for sale to other farmers during planting seasons. Despite these, the diffusion process among farmers was quite encouraging as most farmers got their improved cowpea seeds from their friends or relatives.

This study revealed that income realized from the sale of cowpea was used to pay for children's school fees, buying clothing for the family and pay for medical facilities. In conclusion, since majority of the people in Katsina State are living in rural areas and predominantly farmers yet live in extreme poverty, there is need to strengthen the agricultural sector which paves way for economic growth. Agriculture as a sector is a basis for achieving the millennium development goals (MDGs) in Africa where most of the poor and hungry lives. Increasing food availability and income level allow people to come out of the vicious circle of poverty which helps in achieving goal one of the MDGs. Subsequently, food availability leads to the elimination of child malnutrition and improving health status of the rural poor. Cowpea in this case is an important crop for supplying food and cash during the hungry period just prior to the main harvests of other staple food crops and that the harvest and sale of fresh cowpeas during the

hungry period is mainly done by women. As a legume crop, cowpea is high in protein which can improve child nutrition if promoted in the rural areas.

5.3 Recommendations

1. The Government should give more encouragement to young farmers to engage in massive cowpea production across Katsina State by giving them loans and subsidizing farming inputs so as to remove any barrier that will hinder the production of the crop because they have more mouths to feed and are very energetic for farming.
2. The adoption rate of IT98K-205-8 was high in 2011. The Sudan Savanna Taskforce project should promote more of this variety as it seems to be farmers' favourite.
3. Participation in cowpea related activities and extension contacts have more influence on the adoption of improved cowpea varieties, it is therefore recommended that the project double its efforts in order to increase farmers participation and the number of extension visits in the project community.
4. The major constraints were non-availability of improved seeds and non-availability of fertilizer plus its high cost. Adequate sensitization need to be done by the project in conjunction with government and its extension agents in all the project communities educating farmers on where to access the improved seeds and fertilizers. As a way of addressing challenges faced by farmers, the project should encourage more farmer participation in community organizations as it is a means of sharing information on improved agricultural technologies among the farmers.

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Appendix: I:

ADOPTION OF IMPROVED COWPEA VARIETIES QUESTIONNAIRE (AICPVQ)

N/B:

1. **All grain / seed measurements should be stated in MUDUS. EXCEPT where the farmer is so sure, should you state any measurement in kilogram (kg)**
2. **Land measurements should be clearly stated whether in ACRE or HECTRE1ha=2.47ac. 1ac=0.404ha**
3. **To be sure, probe further how many mudus per hectre or acre to get accurate land measurement**

Name of Enumerator: _____

Questionnaire No: _____

A: SOCIO-ECONOMIC CHARACTERISTICS OF FARMERS

S/N	Variables	Response	Codes
A1	Name of village:		1=Bakam, 2=GinGin, 3=Tarbbani, 4=Yarkanya 5=Dan Kado, 6=Rugar Fari, 7=Farin Dutse, 8=Garu, 9=Kurkujan, 10=Tuje
A2	Name of Farmer:		
A3	Gender [SEX]		1=Female, 2=Male
A4	Age Range of Respondent in years [AGE]		1=15-24yrs, 2=25-34yrs, 3=35-44yrs, 4=45-54yrs, 5=55-64yrs, 6=65yrs and above
A5	Marital status [MSTATUS]		1=Single, 2=Monogamously married, 3=Polygamous married, 4=Widowed, 5= Divorced, 6 =Other (specify).
A6	Ethnic Group:		1= Hausa, 2= Fulani, 3= Igbo, 4= Yoruba, 5= Other (specify)
A7	Type of farmer:		1=Lead farmer, 2 = Seed farmer, 3 = None of the two
A8	Status of road to the nearest city:		(1= Motorable, 2= Not Motorable)
A9	Type of household [HHTYP]		1 =Male headed (monogamous), 2 = Male headed (polygamous), 3 = Male headed (single), 4 = Male headed (polygamous), 5 = Male headed (divorced), 6 = Male headed (widowed), 7 = female headed (husband absent), 8 = female headed (single), 9 = female headed (widowed), 99 =Other

			(specify)
A10	Distance to the nearest city (Km):		
A11	Number of persons in household [HHSIZE]		
A12	Number of household members aged 65 years and above [HHMEM]		
A13	Number of males aged 41- 64 years [MALES]		
A14	Number of females aged 41-64 years = [FEMALES]		
A15	Number of males aged 16-40 years [MALES]		
A16	Number of females aged 16-40 years [FEMALES]		
A17	Number of females aged 6-15 years [FCHILD]		
A18	Number of males aged 6-15 years [MCHILD]		
A19	Number of male children 0 – 5 years[MINF]		
A20	Number of female children 0 – 5 years[FINF]		
A21	Level of education of respondent [EDUCAL]		1 = No formal, 2 = primary, 3 = secondary, 4 = post secondary/tertiary , 5 = Koran, 99 = others (specify) ----------
A22	Educational level of spouse 1 [SPEDUC]		1 = No formal, 2 = primary, 3 = secondary, 4 = post secondary/tertiary , 5 = Koranic, 99 = others (specify) ----------
A23	Educational level of spouse 2 [SPEDUC] (if married to more than one spouse)		1 = No formal, 2 = primary, 3 = secondary, 4 = post secondary/tertiary , 5 = Koranic, 99 = others (specify) ----------
A24	What was your total Farm income before 2008?		
A25	What was your total farm income after 2011?		
A26	Are you a member of any association in this village? [ASSOC.]		1 = yes , 0 = no
A27	If yes, how many years have you been a member?		
A28	If yes, which type of association [ASTYP]		1 = community development, 2 = farmer's association, 3 = cooperative, 4 = religious association, 5 = credit group, 6=Workers

			union, 7= Traders union ,99 = others (specify)----------
A29	Are you engaged in any non-agricultural or off-farm income generating activities [OFF-FARM]		1 = yes, 0 = no
A30	If yes, which type of off-farm activity [OFFTYP]		1 = Trading/Hawking wares, 2= Artisan/ Craftsman 3 = Hunting/Fishing, 4 = Civil service, 99 = others (specify) ----------

B. COWPEA PRODUCTION, ADOPTION AND PATTERN

B1	How many years have you practiced farming? FARMEXP]		
B2	How many hectares of land do your household own? [LANDOWN]		
B3	Who owns the land? [OWNERSHIP] 1 = male spouse only, 2 = female spouse only, 3 = joint ownership, 99 = others (specify)----------		
B4	Are you growing Cowpea? (GROWC)		1=Yes, 0 =No
B5	Number of years of growing cowpea [COWEXP]		
B6	How many hectares of land were under cowpea production before 2008? [LANDSIZE08]		
B7	Do you plant improved cowpea variety?		1= Yes, 0= No
B8	If no, are you aware of improved cowpea variety		1= Yes, 0= No
B9	If yes to B8, Source of information 1=IITA/SS TASKFORCE, 2=ADP/KTARDA, 3= market retailer, 4 = EAs, 5 = friends/relatives, 6 = other farmers, 99 = others (specify) ----------		
B10	If no to B7, do you receive information on variety		1= Yes 0= No
B11	If yes what are the sources of information on varieties? 1: bulletins or handbooks 2: radio, 3: extension agent 4: Neighbor, 5: market, 6: village or community organization, 7: Other(specify) ----------		
B12	In 2011, what was the total land size under improved cowpea [IMPFLDPLTD]		
B13	What was your average total cowpea yield before 2008?		
B14	What was your average total cowpea yield after 2011?		

B15**.** If yes to question (B7) above, indicate the various varieties of cowpea grown on your fields, origin of seeds, source of information and use status. [COWGROWN]

Row	Cowpea varieties	Ever heard? Yes=1 No=0	Source of information 1=IITA/SS TASKFORCE, 2=ADP/KTARDA, 3= market retailer, 4 = EAs, 5 = friends/relatives, 6 = other farmers, 99 = others (specify) ----------	Year of information	Ever Tried on your fields? 1 = yes, 0 = no	Year of adoption 1 = 2009, 2 = 2010, 3 = 2011,	Origin of seeds 1 =SS TASKFORCE/IITA, 2 = KTARDA, 3 = Market retailer, 4 = EAs, 5 = friends/relatives, 6 = other farmers, 99 = others (specify)	Size of plot	Yield (# of bags)	Use status 0 = currently using 1 = started but abandoned
1.	IT97K-499-35									
2.	IT98K-205-8									
3.	IT98K-573-1-1									
4.	IT89-288									

B16. Which of the following **Cropping pattern** is commonly practised in cowpea production in your household? [CPATTERN]

	Cropping pattern	Response	Codes
1.	Cowpea as sole crop		1 = yes 0 = no
2.	Cowpea as major crop in mixture		
3.	Cowpea as minor crop in mixture		

B17. If you grow cowpea as a **Major** crop in mixture with other crops on your farm which other crop is the second most important. ?
(MAJOR)_____

B18. If you grow cowpea as a **Minor** crop in mixture with other crops on your farm which other crop is the Major crop? (MINOR)
_____

B19. What is your observation about the performance of the other crops growing in mixture with cowpea?

_____
_____
_____
_____

B20. Which of the **Farming system** is commonly practiced by your household? [FARMSYST]

Farming system		**Response**	**Codes**
1.	Mono-cropping/sole cropping		1 = yes 0 = no
2.	Mixed cropping		
3.	Mixed farming		
4.	Livestock/pastoral		

B21	Do you have contact with Extension? (CONTACT)		1= Yes 0=No
B22	If yes, what extension structure (VULGA)		1=NGO 2= Researcher 3= ADP/KTARDA 4= other (specify)----------
B23	Extension services requests (number of requests of extension in current farming season): THINCOM		1=once a week, 2 =twice per month, 3 = once per month, 4 =less than once per month, and 5= never

B24	Have you ever participated in any cowpea related extension activities promoted by SS Taskforce during the implementation of its activities? [COWEXT]		1= Yes 0 = No
B25	If yes, indicate the extension activities		1=Training in cowpea production, 2=Training in cowpea utilization, 3= Field day, 4=Demonstration trials, 5= others (specify)
B26	If yes, with which extension institution or agency? EXTAGENCY]		1=SS TASKFORCE/IITA, 2= KTARDA/ADP. 3=NGO, 4= Ministry, 5= Others (specify)-------
B27	How often were you visited by extension agents in the last cropping season? [EXTVIST]		1= Weekly, 2 = Bi-weekly, 3 = Monthly, 4= Quarterly, 5= Never
B28	How would you rate the usefulness of your contact with extension activities? [EXTUSE]		1 = very useful, 2 = useful, 3 = not useful, 4 = can't tell
B29	Do you regularly have information on market price? [MINFORM]		1= yes, 0 = no
B30	If yes, indicate the source(s) of your market information [INFOSOURCE]		1 = market visits, 2 = media (TV/Radio) 3 = other farmers, 4 = middlemen, 5 = friends/relatives, 6 = extension agents, 99= others (specify)----------
B31	What is your assessment of the market price of cowpea over the past 12 months? [COWPRICE]		1 = good market price, 0 = not so good, 3 = low market price
B32	Do you have access to credit for cowpea promotional activities [CREDIT]		1 = yes, 0 = no
B33	If yes, state the sources from which you obtain credit [CSOURCE]		1 = Banks, 2 = Sudan Savanna Taskforce, 3= KTARDA/ADP, 4 = Relatives and friends, 5 = money lender, 6 = government credit scheme, 99 = others (specify) ----------
B34	What was the amount you borrowed in the last 3 years (2009—2011) (Naira) [AMOUNT]		

B35	Purpose of obtaining the credit [CPURPOSE]		1= extension of cowpea farm, 2 = to hire labour, 3 = to buy seeds, 4 = to buy chemicals, 5 = processing cowpea, 6 = to buy food, 99 = others (specify) ----------
B36	Did you repay the loan on time schedule [REPAY]		1 = yes, 0 = no

C: FACTORS INFLUENCING ADOPTION AND CHALLENGES

C1. If you are **currently using or planting** improved cowpea**,** what are the factors influencing you to grow cowpea? [COWFACTOR]

Factors		Response	Codes 1 = yes 0 = no
1.	Drought resistant?		
2.	High yields		
3.	Early maturity?		
4.	Less labour inputs?		
5.	High cash income/profit?		
6.	Disease resistant?		
7.	Pest resistant?		
8.	Soil fertility improvement?		
9.	Grains store better?		
10.	Makes better local foods/Utilization?		
11.	Striga Control		
12.	Food security in the home?		
13.	Others (specify)----------		

C2. Do you keep **Livestock?** [LSTOCK]_____ (1 = yes, 0 = no)

C3. Is your involvement in livestock management influenced by your cowpea cultivation? [LMGT]_____ (1 = yes, 0 = no)

C4. If yes, what are the reasons for keeping Livestock [LREASON]?

Reasons		**Response**	Codes: 1 = yes, 0 = no
1.	For food		
2.	Cash income		
3.	Work		
4.	Social prestige (sign of wealth)		
5.	Transport		
6.	Others (specify)		

Variable		Response	Codes
C5	Do you have any agro-chemical dealer in this village? (fertilizers, insecticides) [AGCHEM]		1 = yes 0 = no
C6	If no, what is the distance to the nearest agro-chemical dealer? [DISTCHEM]		
C7	Where do you purchase your agro-chemicals? [AGROSAL]		1 = open market, 2 = KTARDA/ADP, 3 = input dealer, 4 = other farmers, 5 = friends/relatives, 6 = farmers cooperative, 99 = others (specify) -----------
C8	Is there an improved seed dealer in this village? [SEDELER]		1 = yes 0 = no
C9	If no, what is the distance to the nearest seed dealer?[SEDNEAR]		
C10	What are the sources you get seeds from for your household? [SEDSOURCE]		1 = own produced, 2 = open market, 3 = seed company, 4=community seed producers 5 = neighbor/friends 6 = other farmers, 99 = others (specify)----------

C11. If you are not growing or have never grown improved cowpea varieties in B7 above, please state reasons for not growing this crop.

Reasons		Response	Codes: 1 = yes, 0 = no
1.	Lack of information about the crops?		
2.	Lack of Land?		
3.	High cost of labour?		
4.	Non-availability of seeds when needed?		
5.	High cost of seeds?		
6.	Pests?		
7.	Diseases?		
8.	High labour cost?		
9.	Drought problem?		
10.	No access to credit?		
11.	Low market price, no profit?		
12	Lack of power in decision making?		
13.	Others (Specify)……..		

C12. How would you assess the following cowpea varietal attribute between the various varieties? [VARTIBUTE]

Attributes		Response	Codes 1 = IT97K-499-35 is better 2 = IT98K-205-8 is better 3 = IT98K-573-1-1 is better 4 = IT89-288 is better 5 = Yarmisra is better 6 = Kananado White is better 7 = Dan Ila is better 8 = No difference, 9 = Can't tell
1.	High Yield?		
2.	Maturity time		
3.	Resistance to pest		
4.	Resistance to shattering		
5.	Soil fertility improvement		
6.	Large Grain size?		
7.	Grain colour		
8.	Ease of threshing		
9.	Ease of harvesting		
10.	Grain storage		
11.	Striga control		
12.	Cowpea utilization into diversified food products.		

C13. Have you ever received or given out seeds of cowpea? _____ (1 = yes, 0 = no) [EXCHANGE]

C 14. If yes, please state quantity received or given out and year?

Varieties	Received 1 = KTARDA, 2 = SS TASKFORCE, 3 = EAs, 4 = other farmers, 5 = seed dealer, 6 = relatives, 7 = friends, 8 = cooperatives, 99 = others (specify)----------			Given Out 1 =CBO members 2 = EAs, 3 = other farmers, 4 = seed dealer, 5 = relatives, 6=friends, 7= cooperatives, 99 = others (specify)----------		
	FROM	QTY	YEAR	TO	QTY	YEAR
IT97K-499-35						
IT98K-205-8						
IT98K-573-1-1						
IT89-288						
Yarmisra						
Kananado White						
Dan Ila						

C 15. Labour allocation in cowpea production. Indicate the persons responsible for the following tasks for cowpea production in your household. [LABORL]

Tasks	Family labour 1 = always, 0 = not always, 3 = never			Hired labour 1 = always, 0 = not always, 3 = never	
	Men	women	Children	Men	Women
Land clearing					
Ridging					
Planting					
Weeding					
Harvesting					
Threshing					
Market sales					
Cowpea processing/utilization					

C16. From your personal assessment/observation, do you think those including you who are growing cowpea in this village are deriving benefits? (DENEFITS)_____- (1 = yes, 2 = no)

C 17. If yes, indicate some of the benefits. [COWBENEFIT]?

Variable/benefits		Response	Codes 1 = yes 0 = no
1.	Is it high yield?		
2.	High income/profit from market sales?		
3.	Resistance to drought?		
4.	Early maturity?		
5.	Increase in area under cowpea?		
6.	Household food security?		
7.	Diversified food products from cowpea?		
8.	Soil fertility improvement?		
9.	Training in cowpea utilization?		
10.	Striga control?		
11.	Better grain quality?		
12.	Availability of improved varieties?		
13.	Others (Specify)		

C 18. If high income/profit is one of the benefits you are deriving from growing cowpea indicate how this income is used to improve the welfare of your household. [USEBENEFIT]

Parameter		Response	Codes: 1 = yes, 0 = no
1.	Is it buying nutritious food to feed members of your household?		
2.	To pay school fees for your children?		
3.	To pay bride price/marry?		
4.	Construct houses?		
5.	Buy building materials?		
6.	Purchase a car?		
7.	Purchase Okada (motorcycle)?		
8.	Buy work bull?		
9.	Buy livestock (goats/sheep/cattle)?		
10.	Buy food processing machine?		
11.	Buy radio/CD player		
12.	Buy clothing for self and family members?		
13.	Pay for medical facilities?		
14.	Buy other assets?		
15.	Others (Specify)		

C 19. Out of the Problems tabulated below, which ones most affect cowpea production and other promotional activities in your household? [PROBLEMS]

		Response	Codes: 1 = yes 0 = no
1.	Non-availability of seeds when needed		
2.	High cost of seeds		
3.	Non-availability of fertilizer		
4.	High cost of fertilizer		
5.	Drought (rains and early)		
6.	High labour cost		
7.	Lack of training of cowpea utilization		
8.	Lack of information on improved seeds		
9.	Diseases		
10.	Pests		
11.	Striga infestation		
12.	Laborious work in cowpea production		
13.	Weevils eat up grains		
14.	Low yield		
15.	Low profit		
16.	Low market price		
17.	No access to land		
18.	Others (Specify)		

C20. If you have **abandoned** cowpea production, state reasons for abandoning the cultivation. [USESTATUS]

Factors		Response	Codes 1 = yes 0 = no
1.	Lack of information about the crops?		
2.	Non-availability of fertilizer?		
3.	High cost of fertilizer?		
4.	Non-availability of seeds when needed?		
5.	High cost of seeds?		
6.	Pests?		
7.	Diseases?		
8.	High labour cost?		
9.	Drought problem?		
10.	No access to credit?		
11.	Low market price, no profit?		
12	Lack of power in decision making?		
13.	Others (Specify)……..		

C21. What Improvements would you like to see in cowpea varieties in future? [COWIMPROV]

		Response	Codes 1 = yes 0 = no
1.	Yield stability		
2.	Higher yield than at present		
3.	Early maturity than at present		
4.	Better resistance to grain weevil		
5.	Better resistance to drought		
6.	Better control of Striga		
7.	Good taste/sweetness		
8.	Better quality home-based food		
9.	Improve germination		
10.	Bigger grain size		
11.	Better threshability		
12.	Dough consistency		
13.	Less cooking time		
14.	More floury		
15.	Others (Specify)		

C22. Which of these varieties will you plant in the coming season?

	Cowpea Varieties	Response	Codes 1 = yes 0 = no
1	IT97K-499-35		
2	IT98K-205-8		
3	IT98K-573-1-1		
4	IT89-288		
5	Yarmisra		
6	Kananado White		
7	Dan Ila		

C 23. Assess your cowpea yield vis-à-vis quantity of seeds used in the past 3 years (2009 – 2011) [ASSYILD]

	Varieties	**2009**		**2010**		**2011**	
		Quantity	**Yield**	**Quantity**	**Yield**	**Quantity**	**Yield**
1.	IT97K-499-35						
2.	IT98K-205-8						
3.	IT98K-573-1-1						
4.	IT89-288						
5.	Yarmisra						
6.	Kananado White						
7.	Dan Ila						

***KEY**: Quantity of seeds planted is in mudu; Yield is per 100 kg bag*

Thank you.

Appendix II

Focused Group Discussion for key Informants (Experienced farmers)

	Bakam	Gingin	Jikamshi	Tarbbani	Yarkanya	Dan Kado	Rugar Fari	Farin Dutse	Garu	Kurkujan	Tuje
1. Benefit of growing improved cowpea varieties											
Drought resistant?											
High yields											
Early maturity?											
Less labour inputs?											
High cash income/profit?											
Disease resistant?											
Pest resistant?											
Soil fertility improvement?											
Grains store better?											
Makes better local foods/Utilization?											
Striga Control											
Food security in the home?											
Drought resistant?											
High yields											
Early maturity?											
Less labour inputs?											
2. Constraints to cowpea production											
Lack of information about the crops?											
Non-availability of fertilizer?											
High cost of fertilizer?											
Non-availability of seeds?											
High cost of seeds?											
Pests?											
Diseases?											
High labour cost?											
Drought problem?											
No access to credit?											
Low market price, no profit?											

3. Cowpea varietal selection base on characteristics in ranking order

	Old	**New 1**	**New 2**	**New 3**	**New 4**
	Local	**IT97K-499-35**	**IT98K-205-8**	**IT98K-573-1-1**	**IT89-288**
Production					
Early maturing					
More pods					
High fodder					
White Seed/grain					
High yield					
sub-total					
Post harvest					
Quality food					
Premium price					

4. Benefit of working with the Sudan Savanna Taskforce project

i. ----------
ii. ----------
iii. ----------
iv. ----------
v. ----------
vi. ----------
vii. ----------

Appendix: III

Figure 3: A Simplified Formula for Proportions and Sample size selection table.

Yamane (1967:886) provides a simplified formula to calculate sample sizes. This formula was used to calculate the sample sizes in Figure 3 as shown above. A 95% confidence level and P = .5 are assumed for Equations in Figures 4 and 5.

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision. When this formula is applied to the above equation, we get figure 5:

$$n = \frac{N}{1+N(e)^2} = \frac{21800}{1 + 21800(0.05)^2} = 393 \text{ Farmers}$$

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	A	222	145	83
600	A	240	152	86
700	A	255	158	88
800	A	267	163	89
900	A	277	166	90
1,000	A	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100
a = Assumption of normal population is poor. The entire population should be sampled (Yamane, 1967).				

Appendix: IV

Probit Model estimate of determinants of adoption of improved cowpea varieties in the study area

Variables	B	S.E.	Wald	Sig.
Constant	-3.925	1.114	12.407	0.000
GENDER	0.207	0.639	0.105	0.746
EDUCAL	0.743	0.419	3.141	0.076*
CONTACT	1.158	0.443	6.832	0.009***
COWEXT	2.974	0.416	51.154	0.000***
ASSOC	0.662	0.379	3.053	0.081*
FARMEXP	0.012	0.016	0.624	0.430
-2 Log likelihood	216.5892802			
Cox & Snell R Square	43%			
Nagelkerke R Square	59%			

*NB: * = significant @ 10% probability level; *** = significant @ 1% probability level*

Appendix V

Tobit Model estimate of determinants of adoption of improved cowpea varieties in the study area

Variables	Coefficient	Standard error	t-value	P>|t|
Constant	-146.6628	36.11163	-4.06	0.000
GENDER	45.47679	17.74433	2.56	0.01***
AGERES	-.3558906	.564711	-0.63	0.53
HHSIZE	.3890319	.8425112	0.46	0.65
EDUCA	11.78681	12.1899	0.97	0.33
COWEX	-.1023775	.6354491	-0.16	0.87
CONTACT	24.04992	14.62997	1.64	0.10*
ASSOC	30.31062	12.33824	2.46	0.02**
COWEXT	91.97951	14.20083	6.48	0.00***
LSTOCK	.3954458	.2480392	1.59	0.10*

Number of observations = 300

LR chi2 (10) =145.76

Prob > chi2 = 0.0000

Pseudo R2 = 0.1008

Log likelihood = -649.91329

*NB: *** = 1% probability level of significance, ** = 5% probability level of significance,*

** =10% probability level of significance*

Appendix VI

Figure 4: Definition of variables used in Probit model

Variable	Description
Dependent Variable: PLANTIMPROVAR	The adoption status of the farmer (adopter =1; non-adopter = 0)
Independent Variables	
GENDER	Sex or gender of the farmer (male = 1; female = 2)
EDUCAL	Educational level of the farmer
CONTACT	Farmer's contact with extension service (yes = 1; no = 0)
COWEXT	Farmer's participation in cowpea related extension activities (yes = 1; no = 0)
ASSOC	Farmer's membership to association (yes = 1; no = 0)
FARMEXP	Farmer's years of experience in farming

Appendix VII

Figure 5: Definition of variables used in Tobit model

Variable	Description
Dependent Variable: TIMPROVEDSEEDFSIZE	Total area under land size cowpea production
Independent Variables	
GENDER	Sex or gender of the farmer (male = 1; female = 2)
AGERES	Age of farmer
HHSIZE	Number of persons in farmer's household
EDUCAL	Educational level of the farmer
COWEXP	Farmer's experience years in cowpea production
CONTACT	Farmer's contact with extension service (yes = 1; no = 0)
COWEXT	Farmer's participation in cowpea related extension activities (yes = 1; no = 0)
ASSOC	Farmer's membership to association (yes = 1; no = 0)
LSTOCK	Status of farmer whether he keeps livestocks (yes =1; no = 0)