# IMPACT OF PROMOTED IMPROVED CROP PRODUCTION PRACTICES IN THE SUDAN SAVANNAH TASK FORCE OF KANO-KATSINA-MARADI PILOT LEARNING SITES

**By**

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**A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS**

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**APRIL, 2014.**

## DECLARATION

I hereby declare that this Dissertation titled "**Impact of Promoted Improved Crop Production Practices in The Sudan Savannah Task Force of Kano-Katsina-Maradi Pilot Learning Sites"** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been duly acknowledged in the text and a list of references provided.

**_____** **Date_____**

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## CERTIFICATION

This Dissertation entitled "**Impact of Promoted Improved Crop Production Practices in the Sudan Savannah Task Force of Kano-Katsina-Maradi Pilot Learning Sites**" by Omadachi Ogbodo **UGBABE** meets the regulations governing the award of the Degree of Doctor of Philosophy in Agricultural Economics of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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## DEDICATION

This work is dedicated to the ALMIGHTY GOD whose grace and favour provided the funding for this study; to my late father, Mr. Isaiah Ogbodo Ugbabe who inspired me with the zeal for higher education; to my mother, Mrs Onyeka Ugbabe who caught her husband's vision and invested heavily in my early education, and to my darling wife, Mrs Aminetu Iye Ugbabe whose love, understanding and friendship sustained me throughout the duration of this study.

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**ABSTRACT**

In Kano and Katsina States of Nigeria, some promoted improved crop production practices have been tested since 2008 in a series of farmer-managed field trials in four Innovation Platforms (two each in Kano and Katsina States). The broad objective of this study was to assess the impact of improved crop production practices of Sudan Savannah Task Force (SSTF) among farmers in Katsina State, Nigeria. The specific objectives of the study were to: determine the rates and intensities of adoption, identify and evaluate the factors that influence the adoption of improved crop production practices of SSTF, determine the impact of improved crop production practices of SSTF on the income and technical efficiency of the farming households, identify and evaluate the determinants of escape from poverty among the crop farmers and identify and describe the constraints militating against crops production in the study area. The study used primary data collected in 2011 cropping season with the aid of questionnaires from 300 farming households spanning four Local Government Areas in Katsina State, Nigeria. A sample of households was selected by taking a sample of LGAs; a random sample of villages within each LGA; a random sample of households in each selected village. 30 villages were selected within the clean, conventional and treatment sites. Altogether, 10 households were randomly selected in each village giving a total of 300 households interviewed in the State. The tools used for analysis of the data were: descriptive statistics, adoption index, logistic regression, the double difference estimator, Cobb Douglas stochastic production function and probit regression analysis. The results showed that, out of the 231 crop farmers that had access to SSTF crop technologies, only 59.31% adopted them. The estimated mean adoption rates for the introduced new varieties of maize, sorghum, cowpea, millet and groundnut in the study area were: 67%, 46%, 54%, 46% and 52% respectively. The adopters of the introduced technologies enjoyed an increment of 844.35% in income. The result further showed that the probability of adoption of the recommended SSTF crop production practices was found to decline with increases in the farmer's age, household size, farm size and land tenure variables, while the likelihood of adoption increases with increase in years of crop production experience, years of schooling, amount of credit used, access to extension visit, and average annual income variables. The average technical efficiency of grain farmers was 0.801. The mean technical efficiency for the adopters and non-adopters were 0.87 and 0.65 respectively. The minimum and maximum technical efficiencies estimates for the adopters were 0.59 and 0.92 respectively, while for non-adopters they were 0.28 and 0.83 respectively. Results of evaluation of determinants to escape from poverty among crop farmers in the study area found all the explanatory variables except age of farmers, household size and land tenure to be significant at least in 10% level of probability. The parameters of years of crop production experience and years of schooling revealed that probability to escape from poverty significantly increase ($P<0.01$) as farmers' years of crop production experience and schooling increases. Also, the likelihood to escape from poverty positively increased ($P<0.10$) with the amount of credit used by farmers and access to extension visit. The coefficient of adoption was positive and significant. ($P<0.10$), providing what was referred to as the Average Treatment Effect (ATE). Farm size variable related positively and significantly ($P<0.05$) to the chances to escape from poverty. Market distance was statistically significant ($P<0.01$) but negatively related to the propensity to escape from poverty. High cost and scarcity of inputs, low profit from crop production, problems of output transportation, difficulties in processing and storage, inconsistency in government policy, lack of market information, low quality of produce,

and limited output market outlets were the most prominent problems militating against crop production in the study area. The study concludes that the introduced technologies enhanced the income and efficiency in crop production of the adopters. Some key recommendations from the study were: (i) Strong linkages should be established between farmers and seed/fertilizer sources to improve timely availability of these inputs; (ii) Construction of good access roads that will ease the transportation of crop outputs to major markets.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of the Study

Agriculture constitutes one of the most important sectors of Nigeria's economy. The sector is particularly important in terms of generating employment and contributing to the Gross Domestic Product (GDP) and export revenue earnings (Manyong *et al*., 2004). In the 1960s, the agricultural sector was the most important in terms of contributions to domestic production, employment and foreign exchange earnings. The situation remained almost the same three decades later with the exception that it is no longer the principal foreign exchange earner, a role now being played by oil (National Bureau of Statistics, 2012).

The sector remained stagnant during the oil boom decade of the 1970s, and this accounted largely for the declining share of its contributions. The trend in the share of agriculture in the GDP shows a substantial variation and long term decline from 60% in the early 1960s through 48.8% in the 1970s and 22.2% in the 1980s (National Bureau of Statistics, 2012). Unstable and often inappropriate economic policies (of pricing, trade and exchange rate), the relative neglect of the sector and the negative impact of oil boom were also factors responsible for the decline in its contributions (National Bureau of Statistics, 2012).Generally, the agricultural sector is the single largest sector of the economy, contributing about 41% to the country's GDP (Olayemi *et al*., 2004). It also contributes significantly to national employment, with about 60% of the country's total workforce engaged in agriculture. The sector accounts for most of the country's food

supply and it is also an important contributor to the nation's foreign exchange earnings as well as the supply of industrial raw materials (Olayemi *et al*., 2004).

Nigeria has a total land area of about 98.3 million hectares (Amaza *et al*., 2007). Although, about 71.2 million ha are cultivable, only about 34.2 million ha or 48% of the total cultivable land is actually cultivated (Amaza *et al*., 2007). Due to its high agro-ecological diversity, the country produces a very wide range of agricultural products, consisting of staple food crops, cash crops, livestock, fish, and forest products. Overall, cereals, roots and tuber crops constitute the largest category of agricultural products (Amaza *et al*., 2007).

Nigeria is a nation of small farmers who account for over 90% of the country's total agricultural production. These farmers cultivate small land holdings that are often less than two ha in area and in fragmented plots (Amaza *et al*., 2007).The traditional system of agricultural production still predominates, with its characteristically low technological base, high reliance on manual labour, and hence low resource productivity. Agricultural production still depends heavily on the vagaries of nature; as a result, seasonal and annual fluctuations in agricultural outputs are common (Amaza *et al*., 2007).

Manual farm operations impose severe limits on farmers' capacity to increase their farm sizes and productivity: the manual system of farming is technically inefficient, labour intensive, and costly to sustain (Olayemi *et al*., 2004). Although, the use of animal power for land cultivation has been adapted to a limited extent in the savannah/Sahel belt of the country, its use in other areas is almost nonexistent for ecological and cultural reasons. It has been observed that mechanization of agriculture in the country

has generally made little headway due to technical, ecological, and socioeconomic factors (Olayemi *et al*., 2004).

Performance of Nigeria's agriculture is low. This is because the nation is under utilizing its agricultural potential (Ruhl, 2011). Despite the fact that the sector employed about two-thirds of Nigeria's labour force and contributed 42% to the country's GDP, its productivity is still below average. Productivity has not grown sufficiently due to under-investment in new technology, slow adoption of existing improved technologies, constraints associated with the investment climates and lagging infrastructure. Agriculture remains the main source of growth and an important option for the country in its quest for diversification to non-oil source of growth. The development of commercial agriculture would provide opportunity to increase employment and reduce rural poverty (Ruhl, 2011). Diversification into commercial agriculture is important for making growth sustainable, to diffuse its benefit to rural areas and to hedge against shocks from a single resource dependence on oil (Ruhl, 2011).

The Sub Saharan Africa Challenge Programme (SSA-CP) was initiated in 2004 following extensive consultations with numerous agricultural stakeholders (researchers, extension and development agents, policy makers, farmers and the private sectors) to diagnose the reasons behind the underperformance of agricultural research in Africa (Ayanwale *et al*., 2009). The consultations established that besides inadequate funding, the main impediment to the contribution of Africans agricultural research to development lies in the way the research is organised and conducted. Research, technology transfer and technology use have been treated as independent activities whereby research derived knowledge consisting of large prescriptive technology packages flows linearly from researchers to farmers through extension agents

(Ayanwale *et al*., 2009). The consultations proposed an alternative approach that aims to appropriately embed agricultural research within a larger system of innovation whereby knowledge from numerous sources (comprising all actors and stakeholders) are integrated and effectively put into use. This approach to agricultural research is termed Integrated Agricultural Research for Development (IAR4D) and has been adopted by the SSA CP (Ayanwale *et al*., 2009).

A sustainable and dynamic approach to agricultural development has remained of great concern to the government and priority for discourse in the policy arena (Agwu *et al*., 2008). Past efforts have concentrated on investment in research and development which was established on the consensus that the application of science and technology is responsible for the structural transformation required to propel the agricultural sector (Agwu *et al*., 2008). Public research and extension institutions are projected as the sole source of innovation/knowledge requisite to trigger development in the agricultural sector. Several other relevant macroeconomic and meso level factors such as policy and legislative framework and nature of human capital, physical infrastructure, finance and investment climate and system for facilitating information and knowledge flows were not considered as important (Agwu *et al*., 2008). The emerging reforms and changes in knowledge structure of agriculture explicitly indicate that the traditional agricultural research and extension system alone cannot sufficiently address the challenges of the new trends. Innovation system approach offers a holistic and, multi-disciplinary approach to innovation and processes, incorporating emerging reforms and approaches for agricultural development (Agwu *et al*., 2008).

The Africa Challenge Programme uses the innovation systems approach to solve problems (Sudath, 2006). The innovation systems approach is a holistic approach that has emerged during the past decade and has become well established. Termel *et al*. (2001) defined the agricultural innovation system as a set of agents that jointly and/or individually contribute to the development, diffusion, and use of agriculture related new technologies, and that directly and/or indirectly influence the process of technological change in agriculture. It is widely used in the academic context and as a conceptual framework for innovation studies. It is also a useful tool to study industrial and agricultural innovations in the economy (Sudath, 2006). The systems approach is crucial in identifying economic, social, political, organisational, institutional activities and functions of the innovation system. These activities are conducted by sets of agents that interact to achieve a common goal through exchange of information and by learning from each other (Sudath, 2006). The reality of agricultural innovation is that it involves a more diverse set of agents than is conventionally acknowledged by the linear approach. As a result, innovation requires different sets of functions, the most important ones being technological invention, communication and the adaptation of new ideas for current practice. Every function is equally important, and actors or stake holders need to collaborate in order to achieve innovation (Sudath, 2006).

Termel *et al*. (2001) posited that the major outcome of the extensive consultations with numerous agricultural stakeholders in sub Saharan Africa established that the main impediment to the contribution of African agriculture to development lies in the way agricultural research is organised and conducted. The outcome led to the proposal of an alternative approach that aims to appropriately embed agricultural research within a larger system of innovation whereby knowledge from numerous sources is integrated

and effectively put into use. One of the project aims is to evaluate the effectiveness of the IAR4D concept in its respective Agro-Ecological Zone (AEZ) by establishing Innovation Platform (IP) and conducting action research aimed at intensifying crop and livestock systems, improving access to markets and promoting sustainable management of the natural resource base. In pursuance of the goals of the project, a baseline survey was carried out in the Sudan Savannah zone in 2008 to provide baseline data on socio economics, resource use patterns, market opportunities, agricultural productivity and incidence of poverty in targeted project communities (Ayanwale *et al*., 2009).

## 1.2 Problem Statement

This study came about because of the farmers' inability to adopt previous agricultural technologies that were supposed to be well thought out by Researchers on-stations and the donor agencies with little or no inputs from the farmers themselves. The gap in information between the farmers and the other stakeholders in the agricultural sector necessitated this project. To bridge this gap, innovation platforms were established to foster interaction among a range of stakeholders and strengthen capacity of stakeholders to generate, apply and share knowledge.

Forum for Agricultural Research in Africa's (FARA) SSA-CP PLS programme aims to embed agricultural research into a broader innovation's system approach where knowledge from various sources is integrated and put into use. This is referred to as Integrated Agricultural Research for Development (IAR4D). The fundamental structure for this is an "Innovation Platform" which comprised of a partnership of researchers, extension workers, farmer representatives, traditional leaders, private firms, Non-

Governmental Organisations (NGOs), and government policy makers who interact to support sustainable agricultural development (Ellis-Jones and Kamara, 2010).

SSA-CP operates across three PLS projects[1] of which KKM falls within the West African sub-region and is coordinated by Conference of the Agricultural Research leaders in West and Central Africa (CORAF)/West and Central Africa Council for Agricultural Research and Development (WECARD) and operates across three PLS projects of which KKM falls within the West African sub-region. The KKM PLS comprises three Taskforces, one each in three agro-ecological zones, namely, the Sahel, Sudan Savannah and Northern Guinea Savannah. Each aims to improve the productivity of farming systems and ensuring efficient use of resources through technical, administrative, marketing and management improvements (Forum for Agricultural Research in Africa, 2009) in order to improve the living standards of the benefiting communities. This study was conducted in the Sudan Savannah agro-ecological zone.

The study set out to answer the following research questions:

(i) What are the socio-economic characteristics of the farming households in the study area?

(ii) What are the rates and intensities of adoption of the improved crop production practices of the Sudan Savannah Task Force (SSTF). New crop varieties introduced, burying of fertilizers, plant row spacing, and pesticide application)?

(iii) What factors influenced the adoption of the improved crop production practices of SSTF?

(iv) What are the impacts of the improved crop production practices of SSTF on the income of the farming households in the study area?

(v) What are the impacts of the improved crop production practices of SSTF on the technical efficiency of the farming households in the study area?

(vi) What are the determinants of escape from poverty in the study area?

(vii) What are the constraints militating against crops production in the study area?

## 1.3 Objectives of the Study

The broad objective of this study was to assess the impact of improved crop production practices of SSTF among farmers in Katsina State, Nigeria.

The specific objectives of this study are to:

(i) examine the socio-economic characteristics of the farming households in the study area;

(ii) determine the rates and intensities of adoption of improved crop production practices of SSTF;

(iii) identify and evaluate the factors that influence the adoption of improved crop production practices of SSTF;

(iv) determine the impact of improved crop production practices of SSTF on the income of the farming households in the study area;

(v) evaluate the impact of improved crop production practices of SSTF on the technical efficiency of the farming households in the study area;

(vi) identify and evaluate the determinants of escape from poverty among the crop farmers in the study area;

(vii) identify and describe the constraints militating against crops production in the study area.

## 1.4 Justification of the Study

The Sub Saharan Africa Challenge Programme (SSA CP) is promoting the Integrated Agricultural Research for Development (IAR4D). This new approach builds on Integrated Soil Fertility Management (ISFM) and Integrated Natural Resource Management (INRM) with research on increased productivity and sustainable natural resource management being integrated with research on policies and markets with an emphasis on the interactions between these four factors. The IAR4D approach recognises that, in addition to disciplinary and basic research skills, agricultural scientists and trainers need the ability to put their disciplines into dynamic systems contexts and to integrate the contributions of different disciplines. They also need to be able to develop partnerships and manage change with multiple stake-holders in the agricultural sector and wider society. This will require building and managing interdisciplinary and inter-institutional teams and enabling all stakeholders to participate. The research was backed by facilitation, information and knowledge management, and capacity building to ensure that the approaches of IAR4D will be internalised, implemented, and scaled out and up to have national and continental level impact on improving the livelihoods of African smallholders and pastoralists (Kaufman, 2007).

Impact assessment is seen as a critical component of agricultural project that helps to define priorities of project and facilitate resource allocation among programmes, guide researchers and those involved in technology transfer to have a better understanding of

the way new technologies are assimilated and diffused into farming communities, show evidence that clients benefit from the project products (Manyong *et al*., 2001).

Impact studies are needed to measure benefits and compare them with the costs of implementation. With careful evaluation of research impacts, scientists can target their work to achieve the greatest possible payoffs. Documentation of research impacts is also needed to ensure an appropriate level of public support. Without clear and persuasive demonstrations of its benefits, research is unlikely to attract sustained funding it needs to be successful. Due to the fact that the gains from research are not self-evident, research will not receive appropriate levels of support or guidance unless they are discovered and disseminated through regular impact assessments (Masters, 1996). Moreover, impact study is needed to enable researchers document accountability for past funding, build a track record to attract new funding, build broad awareness to ensure political support, and guide the research agenda to achieve national priorities.

Issues of technology adoption among agricultural producers have received tremendous attention of agricultural development planners over decades (Saka and Lawal, 2009). Studies according to D'souza *et al*. (1993) have generally focused either on technology adoption process at the farm level or on identifying the significant characteristics associated with adopters of individual technology. Regardless of whichever is the focus, adoption is generally a decision at the individual farmer's level, subject to various constraints bothering on resource (human and material) endowment and time variation which makes adoption a dynamic process.

In some cases, however, it is considered to be more beneficial to focus on the latter with the principal aim of targeting specific variables for policy formulation or specific group of farmers to promote the adoption of an innovation. Technology adoption literatures have however grouped factors affecting technology adoption under human capital, structural, institutional, and environmental categories (Feder and Slade, 1984; D'souza *et al*., 1993; Isham, 2002).

Integrated Agricultural Research for Development (IAR4D) is highly justified in Africa and Nigeria now because of failed past attempts at agricultural developments that neglected the major stakeholders' (rural poor farmers) involvement at technology conception stage. This project report will help policy makers to reshape policies about future research methodologies and provide useful materials for scientists and researchers. It will also add to the pool of literature on research methodologies for development.

### 1.5 Hypotheses

The hypotheses stated below were tested:

(i) Socio-economic characteristics of the farming households have no influence on the adoption of the SSTF recommended practices.

(ii) Adoptions of SSTF recommended practices have no impact on household income and technical efficiency of the farming households.

(iii) Adoption of the SSTF recommended practices does not influence escape from poverty among the farming households' in the study area.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 The Farming Systems of Sudan Savannah, Nigeria

The productivity of the farming systems in the Sudan Savannah of the Kano-Katsina-Maradi Pilot Learning Sites (KKMPLS) is low (KKM, 2008). Results from the validation exercise conducted in the KKMPLS indicate low adoption of improved technologies. Land degradation, diseases, insect pests, *Striga* infestation, lack of labour-saving technologies for field operations and processing, and inadequate supply of yield-enhancing inputs are serious constraints to intensification of farming systems (KKM, 2008). Market- related constraints include limited access to credit, low farm-gate prices, high cost and low quality of inputs, poor access to output markets, and weak linkages between producers, agro-industry and markets. Policy-related constraints include conflicts arising from access to community resources and utilization especially between farmers and pastoralists (KKM, 2008). Ineffective extension systems and lack of policy incentives also constrain agricultural intensification. The project demonstrated the effectiveness of innovation systems in supporting the development and adoption of market driven crop/livestock productivity enhancing technology options. In order to influence development through widespread adoption of technologies and improve income of stakeholders, enabling conditions in the realms of markets and policies need to be fostered, along with harmonization of distinct institutional agendas and practices among a diversity of actors (e.g. farmers' associations, entrepreneurs, Non Governmental Organizations (NGOs), Community Based Organizations (CBOs), development-oriented organizations, ministries, and research and extension agencies) (KKM, 2008).

A three year study of the ways small-scale farmers operate in Africa, Asia and Latin America has highlighted the consequences of weak representation of small scale producers in agricultural policies and prompted calls for a major rethink and restructured approach to the success of the development and welfare of small scale farmers (Bangudu, 2014). The Nigerian small-scale farmer has been the major producer of food and cash crops in the country. Due to urbanisation and rapid growth in population, the agricultural sector of the economy has not been able to cope with the increasing demands made on it. This has seriously led to massive importation of various food items and raw materials to augment this shortage in supply. Due to relative cheaper imports, however, the terms of trade of the small-scale farmer has progressively worsened since he uses very limited capital inputs as compared with his foreign competitors (Akinyosoye and Adegeye, 1993). The farmer gets limited returns from his farm produce in spite of the much effort he exerts to increase his income. It has been found that the primary cause of this unsatisfactory situation is the traditional system of agricultural production (Olayemi, 1991). The introduction of improved technologies, in the form of high yielding seeds, fertiliser, insecticides, and tractors has been the major strategy of the Federal and State Governments. Particular worry has been expressed about the northern-most drought-prone part of the country bordering Niger Republic, which is poor, arid and marginal for agriculture but densely populated and politically important in the national balance (Idachaba, 1985).

The Nigerian agricultural industry's poor performance despite various efforts made by government in increasing food production has been blamed on poor allocation and management of resources, low level of technology, inadequate capital, poor economic infrastructure and lack of adequate incentives amongst others (Sanni, 1991). Low level

of uptake of technologies is said (Mudahar, 1974) to be responsible for agricultural sector's low level and stable economic trap. One of the major tasks facing Nigerian agriculture is the provision of an adequate and stable food supply to meet the requirement of a growing population. Although food availability has increased along with growing human population, there are still 800 million people globally suffering from malnutrition (Food and Agriculture Organization, 1993).

The technologies taken to farmers, though technically feasible may not be easily utilized by the farmers due to resource restrictions, low income level of farmers, pay-off of technologies, government conflicting programs and the level of mental and intellectual development of farmers. These factors may prevent the farmers from adopting these practices in totality leading to a wide gap between the yield farmers are obtaining from field and those that are potentially possible under improved conditions (Sanni, 1991).

Food insecurity is a central concern and a fundamental challenge for human welfare and economic growth in Africa. Low agricultural production results in low incomes, poor nutrition, vulnerability to risks and lack of empowerment. Land degradation and soil fertility depletion are considered the major threats to food security and natural resource conservation in sub-Saharan Africa (SSA). Investments in technology, policy and institutional reforms are needed to increase agricultural productivity to ensure food security and sustained national economies. Past research has generated numerous soil fertility management technologies which if adopted could propel the African continent out of the poverty trap. However, these technologies have had little, if any, impact due to low adoption by the small holder farmers. Africa needs to break the cycle between

poverty and land degradation by employing strategies that empower farmers economically and promoting sustainable agricultural intensification using efficient, effective and affordable agricultural technologies. In addition, farmers and local entrepreneurs need to be linked to markets to increase their capacities to invest in sustainable land management (Bationo *et al*., 2007).

## 2.2 The Sub-Saharan Africa Challenge Programme (SSA-CP) and Technologies Promoted

The Forum for Agricultural Research in Africa (FARA) "Strategy and Lessons Sharing Forum Workshop (2009)" stated that the SSA-CP was initiated in 2004, with the aim of facilitating a substantial increase in the impact of agricultural research and development for improved rural livelihood, increased food security and sustainable natural resource management throughout Sub-Saharan Africa. To achieve this objective, the SSA-CP proposed a new approach to conduct agricultural research, named Integrated Agricultural Research for Development (IAR4D). This approach entails a multi-sectoral orientation to problem diagnosis, and draws on integrated approaches using "hard" and "soft" sciences to provide solutions, while making the most of the available resources. This concept is premised on an innovation system approach and requires systemic interaction among all stakeholders around a specific commodity or production system. This interaction gives the opportunity for joint problem identification, prioritization and innovation of viable solutions. To facilitate such collaboration between the different stakeholders, the SSA-CP has proposed to create "Innovation Platforms" (IPs) as a vehicle to bring the different Stakeholders together to improve and accelerate the agricultural innovation process (Strategy and Lessons Sharing Forum Workshop, 2009).

The Sub-Saharan Africa Challenge Programme's (SSA-CP's) purpose is to address the most significant constraints to reviving agriculture in Africa (failure of agricultural markets, inappropriate policies, and natural resource degradation) with a new paradigm, Integrated Agricultural Research for Development (IAR4D). This will foster synergies among disciplines and institutions along with a renewed commitment to change at all levels from Farmers to national and international policy makers (Strategy and Lessons Sharing Forum Workshop, 2009). The programme developed technologies for intensifying subsistence orientated farming systems, small holder production systems that are compatible with sound natural resource management, improve accessibility and efficiency of markets for smallholder and pastoral products, and catalyze the formulation and adoption of policies that will encourage innovation to improve the livelihoods of smallholders and pastoralists (Strategy and Lessons Sharing Forum Workshop, 2009).

## 2.3 Adoption of Farming Technology

Rogers (1995), defined adoption as the decision to make full use of an innovation or technology as the best course of action available. Adoption of a new agricultural innovation or practice requires that the farm operator be aware of the practice, becomes interested in it, evaluate it, try it out, and then take steps of adoption. Ganpat and Seepersad (1996) indicated that for a successful adoption of a technology, farm operators must not only know about it, but must be able to follow the recommendations given. Abalu *et al*. (1979) reported that when farmers find recommended farm innovations not to be technically feasible, economically viable, and culturally compatible, they often reject such innovations.

The rate of adoption is defined as the relative speed with which members of a social system adopt an innovation. It is usually measured by the length of time required for a certain percentage of the members of a social system to adopt an innovation (Rogers, 1962). The rates of adoption for innovations are determined by an individual's adoption category. In general, individuals who first adopt an innovation require a shorter adoption period than later adopters.

Rogers (1962) inferred that "within the rate of adoption, there is a point at which an innovation reaches critical mass. This is a point in time within the adoption curve that enough individuals have adopted an innovation in order that the continued adoption of the innovation is self-sustaining. "In describing how an innovation reaches critical mass, (Rogers, 1962) outlined several procedures that help an innovation to reach this stage. These procedures are: have an innovation been adopted by a highly respected individual within a social network; creating an instinctive desire for specific innovation; inject an innovation into a group of individuals who would readily use it; and provide positive reactions and benefits for early adopters of an innovation.

Investopedia (2011) defined rate of adoption as "the number of members of a society who start using a new technology or innovation during a specific period of time. The rate of adoption is a relative measure, meaning that the rate of one group is compared to the adoption of another, often of the entire society. Attributes of an innovation that affect the rate of adoption includes: the advantage created by adopting the innovation, the ease at which the innovation can be adopted into daily life, the ability of other members of society to see those who have already adopted the innovation and the expense associated with trying the innovation."

The adoption rate is part of the diffusion of innovations theory, which seeks to explain how the use of new technologies, processes and innovations spreads through a society, and why they are adopted over old methods. One major factor that influences the rate of adoption is the type of society that is being introduced to an innovation, as closed societies and societies without clear communication between adopters and non-adopters are less likely to take new technology (Investopedia, 2011).

Earlier studies (Seyoum *et al.*1998, Obwoma, 2000, and Ajibefun, 2006) found that the low rate of adoption of improved agricultural technologies could be due to low expected benefits from the practice, or could be due to other factors such as farmers' characteristics or technology factors which may not encourage the adoption of technologies by farmers.

Adoption rate and adoption intensity will yield equivalent results when farm sizes are roughly the same and/ or the rate of adoption is constant across farm sizes, which often is not the case (Morris *et al*., 1999). Frequently, farm sizes vary and adoption rate differ, with farm size meaning a particular innovation is taken up with greater frequency by large-scale farmers, or vice versa. Under these circumstances, the proportion of farmers adopting the innovation can differ significantly from the proportion of the total cultivated area that is affected by the innovation (Morris *et al*., 1999).

## 2.4 Factors Affecting the Adoption of Promoted Agricultural Technologies

In their study of " determinants of adoption and productivity of improved rice varieties in south-western Nigeria, Saka and Lawal (2009)found that, land area cultivated to rice,

frequency of extension contact, and the yield rating of the improved rice varieties were significant determinants of farmers' decision to adopt improved rice varieties.

Atala (1980) found that socio-economic factors such as age, household size, formal education, farm size, and income, and community status were related to adoption of technologies. Ekong (2003) stated that the following factors influence the adoption of new technology: age, education level, farm size, income, values, norms, cultural beliefs, and contact with extension, cost and economic feasibility of innovation, complexity, social status, personal characteristics and nature of the community.

Nsabimana and Masabo (2005) reported that the factors which promote the adoption of agricultural technologies developed and disseminated by *Institut des Sciences Agronomiques du Rwanda* (ISAR) include: sensitization on advantages of the technology, literacy, age, technical information and exposure to the technology. In addition there is a need for farmers to have access to credit.

Human capital factors include educational background of the farmer, age or experience in farming. While education is expected to have positive association with adoption decision, *a priori* expectation on the influence of age is negative, as younger farmers are expected to be more receptive to new innovations. Institutional factors include processes that facilitate build-up of social capital, contact with extension information, group participation, credit and alternative sources of income which are all expected to have positive influence on adoption decision. In addition to these are specific attributes of the technology under focus (Feder and Slade, 1984; D'souza et al., 1993; Isham, 2002). Mutandwa *et al*. (2007) in their study to identify the factors that affect adoption of long staple cotton (LS9219)

variety among smallholder cotton farmers in Matepatepa communal area of Mashona land Central province of Zimbabwe, found that agricultural credit have a positive and significant effect on adoption, while large farm size was negatively associated with adoption of LS9219 variety. They stated that there is a need for holistic approach in which agricultural credit and sufficient price premiums for long staple varieties are central for long term sustainability.

## 2.5 Impact of Agricultural Technologies

Impact evaluation assesses the changes that can be attributed to a particular intervention, such as project, programme or policy, both the intended ones, as well as ideally the unintended ones (World Bank, 2008). In contrast to outcome monitoring, which examines whether targets have being achieved, impact evaluation is structured to answer the question: how would outcomes such as participants' well-being have changed if the intervention had not been undertaken? This involves counterfactual analysis, that is, "a comparison between what actually happened and what would have happened in the absence of the intervention (White, 2006)."

Impact evaluation helps us to answer key questions for evidence-based policy making: what works, what doesn't, where, why and for how much? It has received increasing attention in policy making in recent years in both western and developing country contexts (Gertler *et al.,* 2011). It is an important component of the armoury of evaluation tools and approaches and integral to global efforts to improve the effectiveness of aid delivery and public spending more generally in improving living standards.

The literature about economic impacts of programme intervention emphasizes the importance of establishing the appropriate counterfactual. As stated by Ravallion (1994), "the essential problem of impact evaluation is that we do not observe the outcomes for participants if they had not participated." The appropriate counterfactual facilitates measurement of the correct causal relationship between the technology and the outcomes being measured, because other confounding factors may also have influenced the outcome (Ravallion, 1994; Baker, 2000; Doss, 2000).

Ravallion (1994) summarized and compared the five main methods available for evaluating programme impact. Using randomization, individuals are selected into treatment and comparison groups at random, so that the only measurement errors are associated with sampling. Sampling errors can be reduced through larger samples. In the matching approach, the comparison group is matched to the treatment group based on characteristics measured in data from a larger, representative sample survey. Propensity scores are tabulated to support the selection of individuals. Reflexive comparisons enable the "before and after" to be estimated for key parameters using a baseline, which serves as the comparison group. With the double difference method, the treatment and comparison group are compared both before and after the treatment. The fifth approach is the instrumental variables approach. Instrumental variables are those that matter to participation, but not to the outcome. They enable the identification of exogenous variation in outcomes that can be attributed to the programme. The participation variable is the decision to use new crop hybrids.

The terms impact assessment or evaluation are often used interchangeably by many writers or authors, but the two are not the same. Impact refers to the broad, long-term economic,

social and environmental effects resulting from project, while evaluation/assessment is judging, appraising or determining the worth, value or quality of project, in terms of its relevance, effectiveness, efficiency and impact (Impact Assessment and Evaluation Group, 1999). Impact assessment is an established practice in public goods investment project and programmes such as infrastructure, health, education, transportation, and urban development.

According to Alene *et al*. (2006) impact assessment of agricultural project is viewed as an important activity to ensure accountability, maintain credibility and improve internal decision-making processes and the capability to learn from the past experience. Impact assessment is seen as a critical component of agricultural project that helps to define priorities of project and facilitate resource allocation among programmes, guide researchers and those involved in technology transfer to have a better understanding of the way new technologies are assimilated and diffused into farming communities, and show evidence that clients benefit from the project products (Manyong *et al*., 2001).

Impact studies is of great importance in agricultural research because it is used to identify alternative technologies that would address the major production constraints while at the same time taking into consideration farmers preferences and farming condition (Alene *et al*., 2006). Programme impacts refer to the set of results, such as changes in access to and quality of resources, changes in behaviour, or well-being that occur at the beneficiary level and that can be directly attributed to programme activities and outputs. Program impacts can be further broken down to according to Aneke. (2007) as;

**a) Impacts on capability**, which is referred to as intermediate level program outcomes; this include improvements in the access to, or quality of resources, and improvements in the knowledge and practices of beneficiaries. These intermediate impacts provide beneficiaries with the necessary tools to bring about sustainable improvements their own food security status and general well-being. Improved access to working capital as part of micro-enterprise development activities, as well as the improved knowledge and behaviour, which can result from education and training efforts, are examples of program impacts which influence beneficiary capabilities.

**b) Impacts on well-being**, which refers to the final program results at the beneficiary level that are directly related to their food security status and well-being. The impacts of agricultural programs may best be measured in terms of changes in crop yields, food production and incomes.

Impact studies rely on the construction of a counterfactual-an attempt to estimate what a given outcome would have been for the beneficiaries of a programme if the programme had not been implemented. Impact studies thus address causality and allow results to be attributed to specific interventions (Rawlings and Shady, 2002). Normally if the comparison group is correctly identified, the difference between the treatment and comparison groups isolates the effect of the intervention (Chase, 2002).

It is noteworthy that a better yield from any technology does not necessarily translate to a higher income and asset endowment due to certain factors that condition income generation. One of such significant condition is cost. Two technologies might give the same yield but different yields because of costs incurred on factors employed in operating

such technologies (Akinola, 2007). Farmers' adoption decisions and the subsequent impact on their livelihoods are conditioned by assumed maximization of expected returns subject to such conditions (Rahm and Huffman, 1984). Normally, adoption stimulates agricultural growth, improves employment opportunities, and expands food supply-all central to the alleviation of poverty (Binswanger and Haddad, 1990).

Technical efficiency is the firm's ability to produce maximum output given a set of inputs and technology (Farrel, 1957). Technical efficiency is just one component of overall economic efficiency. Profit maximisation requires a firm to produce the maximum output given the level of inputs employed (technical efficiency), use the right mix of inputs in light of the relative price of each input (input allocative efficiency), and produce the right mix of outputs given the set of prices (output allocative efficiency) (Kumbhaker and Lovell, 2000). Generally, the gamma parameter $\gamma = \sigma_u^2 / \sigma_v^2$ lies between 0 and 1; with a value equal to 0 implying that technical inefficiency is not present and the ordinary least square estimation would be an adequate representation and a value close to 1 implying the frontier model appropriate (Piesse and Thirtle, 2000).

The level of technical efficiency of a particular firm is characterised by the relationship between observed production and some ideal or potential production (Greene, 1993). The measurement of firm specific technical efficiency is based upon deviations of observed output from the best production or efficient production frontier. If a firm's actual production point lies on the frontier, it is perfectly efficient. If it lies below the frontier then it is technically inefficient, with the ratio of the actual to potential production defining the level of efficiency of the individual firm.

Technical efficiency is defined as the ratio of the observed output to the corresponding frontier and is estimated from the composed error term (Kibaara, 2005). Kibaara reported in her study that the mean technical efficiency of Kenya's maize farmers was 49%, but ranged from 8% to 98%. She stated further that there was a distinct intra and inter-regional variability in technical efficiency as well as by cropping system with the mono-cropped maize fields having higher technical efficiency than the intercropped maize fields. Kibaara found that the number of years of school the farmers has had in formal education, age of the household head, health of the household head, gender of the household, use or none use of tractors and off-farm income had impact on technical efficiency.

He found the use of hybrid maize increased technical efficiency by 36%. Households that used tractors increased technical efficiency by 26% and an additional year in school increased technical efficiency by 0.84%. The study further revealed that a maize producer needs only an elementary education (five years of school) to be technically efficient (Kibaara, 2005).

## 2.6 Review of Analytical Tools for Adoption and Impact Studies

### 2.6.1 Descriptive statistics

Descriptive statistics describe the main features of a collection of data quantitatively (Mann, 1995). Descriptive statistics are distinguished from inferential or inductive statistics, in that descriptive statistics aim to summarize a data set, rather than use the data to learn about the population that the data are thought to represent. This generally means that descriptive statistics, unlike inferential statistics, are not developed on the

basis of probability theory (Dodge, 2003). Even when a data analysis draws its main conclusions using inferential statistics, descriptive statistics are generally also presented. Descriptive statistics provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of quantitative analysis of data.

Descriptive statistics is the term given to the analysis of data that helps describe, show or summarise data in a meaningful way such that, for example, patterns might emerge from the data. Descriptive statistics do not, however, allow us to make conclusions beyond the data we have analysed or reached conclusions regarding any hypotheses we might have made. They are simply a way to describe our data (Laerd.com, 2014). Typically there are two general types of statistic that are used to describe data: Measures of central tendency (mode, median and mean) and measures of spread (range, quartiles, absolute deviation, variance and standard deviation) (Laerd.com, 2014). Inferential statistics arise out of the fact that sampling naturally incurs sampling errors, and thus a sample is not expected to perfectly represent the population. The methods of inferential statistics are: (1) the estimation of parametres and (2) testing of statistical hypotheses (Laerd.com, 2014).

### 2.6.2 Adoption rate (adoption index)

Over the years, two methods of determining adoption rate have been established in literature; the first is based on expressing the number of farmers adopting a particular technology as a percentage of the total number of farmers under study (Floyed *et al*., 1999) and the second, expressing the land area put under a particular technology as a percentage of the total land area grown to the crop (Akino and Hayami, 1975, Ahmed and Sanders,

1991, and Philips *et al*., 2000). While the former is said to be subjective in the sense that adequate consideration is not given to variation in size of holdings between adopters and non-adopters (Philip *et al*., 2000), the latter is more applicable to crop production with an additional advantage of providing for easy determination of the contribution of the technology to the production of the particular crop within the study area. For this study, the latter method was used.

### 2.6.3 The logistic regression model

In most cases, analytical models used to assess adoption of agricultural technologies have been based on the dichotomous approach of describing whether or not a farmer adopts a complete or few components as against the continuous model which supports the measurement of intensity of use (Mbaga-Semgalewe and Folmer, 2000). The dichotomous (yes and no) approach has been found to be more appropriate measure for discrete choice (binary) framework, otherwise known as Qualitative, Quantal or Categorical models prominent among which are the Probit and Logit models with principal features of having an endogenous random variables assuming values of 1 (yes) and 0 (no) (Adesina and Zinnah, 1993, Jabar *et al*., 1998 and Baidu-Forson, 1999).

The binary models are designed with both deterministic and random utility components in order to accommodate unknown and unobserved attribute of an alternative in the individual utility function. Usually, the probability of selecting an alternative by an individual consumer (in this wise farmer) is based on the promise that the utility derivable from such choice would exceed that from any other alternative in the pool.

Dichotomous (binary) logistic regression model was used to evaluate the factors influencing the adoption of the SSTF improved crop production practices. The figure 1 will be used for farmers adopting the challenge program technologies, while 0 will represent farmers not adopting the technologies.

The logistic cumulative probability function can be expressed as;

$$Pi = E(Y = 1^1/\times_1) = 1/1 + e^{-}(B_0 + B_1 \times_1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

To make it easier, one can rewrite the equation as;

$$Pi = \frac{1}{1 + e^{-z}} = \frac{e^z}{1 + e^z} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$Pi$ =The probability that the person will adopt the technologies

$e$ represents the base of the natural logarithms

$$Zi = B_0 + B_1 \times_1 + \cdots\cdots + B_n X_n \cdots\cdots. \quad (3)$$

Z ranges from $-\infty$ to $+\infty$

Z though a linear combination of variables that have both upper and lower bound, none will be used as the variable Z. This is because the value of Z will depend on the value of the unknown parameters$\beta_{is}$. To obtain the value of Z, the likelihood of observing the sample will be formed by introducing a dichotomous response variable Y, such that;

$Y_i$ = 1 if household adopts the improved crop production practice and 0 if household do not.

P ranges from 0 and 1

Pi is nonlinearly related to Zi (Xi).

Pi, the probability of adopting the Africa Challenge Programme improved crop production practices is given as equation (6), then the probability of not adopting the improved crop production practices (1-Pi) will be expressed as,

$$1 - Pi = \frac{1}{1 + e^{zi}} \cdots\cdots \quad (4)$$

Therefore,

$$\frac{Pi}{1 - Pi} = \frac{1 + e^{z}}{1 + e^{-z}} = e^{z} \cdots\cdots \quad (5)$$

Taking the natural log of equation (5)

$$Li = \ln\left[\frac{Pi}{1 - Pi}\right] = Zi = B_0 + B_1 \times_1 + \cdots\cdots + B_n \times_n \cdots\cdots \quad (6)$$

Where:

L = log of the odds ratio, not only in X, but also in linear parameters. It is called the logit or logit probability model. This implies that the logistic model explained in the equation is based on the logitof $Z_I$,

$Z_i$ = Stimulus index

### 2.6.4 The double difference estimator and the t-statistic

**The double difference estimator**

This was used to achieve objectives (iv). Double difference method is a standard programme evaluation tool used to measure potential impacts (Verner and Verner, 2005). The double difference estimator was used in this study to measure the impact of SSTF crop production practices' adoption on the farmers. The difference in difference (or "double difference") estimator is defined as the difference in average outcome (here, income in Naira) of the beneficiary group before and after treatment minus the difference in average outcome in the non-beneficiary group before and after treatment: it is literally a "difference of differences." Double difference method is a standard programme evaluation tool used to measure potential impacts (Verner and Verner, 2005). To use this model, information on both project participant and non-participant is often required for before and

after programme intervention. The Verners model adapted for this study is specified as follows:

$$DD^{s} = \left[\left(\frac{1}{P}\sum_{i}^{P}(Y_{tia} - Y_{tib})\right) - \left(\frac{1}{C}\sum_{j}^{C}(Y_{oja} - Y_{ojb})\right)\right] \cdots\cdots (7)$$

Where:

$Y_{ti}$ =Total revenue or income at time a and b

Time a and b = after and before project respectively

P = number of participants

C = number of individuals in the control group (non-participant)

$DD^{s}$ = the difference between the average changes in the income for the participant and non-participant

While calculation of rates means, frequency distribution, and percentages may be adequate for some exploratory studies, more detailed and higher level analysis will be required for case studies and sample surveys especially those that deal with qualitative data (Eboh, 1998) like impact analysis. For analyzing dependence, multiple regressions are used. For analyzing relationships whose dependent variables assume a discrete or dichotomous value, qualitative choice models are used. In such relationships, the probability of an event occurring is a function of a set of non-stochastic explanatory variables and a vector of unknown parameter. Following Amemiya (1981) the general form of the univariate dichotomous choice model can be expressed as:

$$Pi = Pi(Y = 1) = G(XiΦ)(i = 1,2 \cdots\cdots n) \cdots\cdots \quad (8)$$

Where:

$P_i = P_i (Y_i = 1)$ is the probability of an outcome. It is a function of the vector of explanatory variables $X_i$ and unknown parameter Φ.

$X_i$ = Explanatory variables.

Φ = Unknown parameters.

Because the functional form of G is unknown, practical applications of the model are not feasible (Amemiya, 1981) so an explicit functional specification of G becomes necessary. Three functional relationships, often specified are the linear probability, probit and logit models. The dichotomous dependent variable model that will be used in this study is logit (the standard normal distribution function). The model is specified in the general form thus:

$$\text{Log}\, P/1 - P = \text{Log}\, 0i = \propto i + \beta_1 \times_1 + \beta_2 \times_2 + \beta_3 \times_3 + \cdots\cdots + \beta_n \times_n \cdots\cdots \qquad (9)$$

Where Log P/1-P = log of odds of participating farming households in the intervention programme,

$\propto$=Constant

$\beta$ =Coefficients and

$\times_n$= Socioeconomic characteristics of the respondent

In most impact estimation, the problem is the issue of taking care of observables and unobservable factors that influence impact. Ordinarily, an OLS regression of the outcome indicator (e.g expenditure per capita) on participation and other explanatory variables used in targeting participants can be used to determine the effect of participation. However, the observed variables that influence participation conditional on some observables may also be influencing expenditure per capita, the outcome indicator, thereby making it difficult to isolate the effect of benefitting from a programme. In other words, the error term in

participation was correlated with the error term in expenditure/capita equation example in equation (10):

$$Pi = a + eZi + vi \cdots\cdots\cdots\cdots \quad (10)$$

$E/C = a + bPi + cxi + ei \cdots(10)$, vi may be correlated with ei.

Some methods which can deal with these problems have been identified. Hence in rigorous estimation of impact, the methods normally used are randomization, propensity score matching, instrumental variables and double difference (Ravallion, 2001; Rawlings and Schady, 2002). Randomization assigns "treatment" through some sort of balloting or lottery allowing researcher to construct treatment and control group. In other words, the selection into treatment and comparison groups is random in some well-defined set of people (Ravallion, 2001). Randomization is immensely appealing because if the sample is large enough, this method controls for all differences, observable and unobservable, between the treatment and control group; simple differences in mean outcomes between the two groups or differences in changes in outcomes, can then be credibly interpreted as the impact of the treatment on the treated (Rawlings and Schady, 2002).

**The t-statistic**

The t-test statistics used in this study to analyze the impact of crop production practices of SSTF on the crop farmers' income is specified in equation (11).

$$t = \frac{\overline{\times}_A - \overline{\times}_{NA}}{\sqrt{\frac{varA}{nA} + \frac{varNA}{nNA}}} \ldots\ldots\ldots\ldots\ldots\ldots \cdot\cdot (11)$$

$\overline{\times}_A$= Mean of adopters

$\overline{\times}_{NA}$= Mean of non adopters

$var_A$=Variance of adopters

$var_{NA}$=Variance of non adopters

*The bottom part of the equation is also called the standard error of the difference.

## 2.7 Review of Previous Studies on Adoption and Impact

### 2.7.1 Adoption rate (adoption index)/adoption intensity.

Saka and Lawal (2009) used the adoption rate formula that was used in this study. Result from their study showed that farmers responded appreciably to intervention programme that promoted the use of improved rice varieties with an adoption rate of 69%. This resulted in an estimated proportional production increase of 19%.

Wanjiku *et al.* (2003) used the Tobit regression model in their study on the "socio-economic factors influencing the intensity of use of bio mass transfer in food crop production in western Kenya," and found that, education, contact with technology promoters, labour demand of the technology, hired labour, and technology profitability among other factors influenced the intensity of adoption. The study recommends that educational efforts and frequent contact with technology promoters be intensified. They further stated that the already acquired knowledge of the technology by adopters can be exploited to benefit other farmers and also to improve on it by use of farmers' field schools.

### 2.7.2 The logistic regression model

Johnson *et al.* (2010) used binary logit regression models to estimate factors affecting adoption of recommended management practices in Stocker Cattle Production in United

States of America. They analyzed variables which include: aspects of farm structure, human capital, farm objectives, and production system employed by the producer. The results revealed that, operation size and dependency upon income from the stocker operation, in particular, influence the adoption of recommended practices. Older producers and those pursuing a year round production strategy were found to lag in production.

Idrisa *et al*. (2010) from their study of "influence of farmers' socio-economic and technological characteristics on soybean seed technology adoption in southern Borno State, Nigeria using the logit model " revealed that, farm size and expenditure on hired labour were the most important socio-economic factors that significantly ($P \leq 0.05$) influenced the likelihood of adoption of improved soybean seeds among the respondents, while yield of soybean ($P \leq 0.01$), household utilization ($P \leq 0.05$) and maturity period of soybean ($P \leq 0.05$) were the significant technology characteristics that influenced the likelihood of adoption of improved soybean seeds by farmers in the area. Based on the findings of this study, it was recommended that: labour-saving technologies be made available to farmers in order to cushion the effect of their expenditure on hired labour, farmers should also be linked to sources of financial support so as to enable them afford hired labour.

### 2.7.3 Impact studies

Isham (2002) showcased the positive impact of social capital by predicting that farmers that have neighbours that adopt technology or those with higher level of social capital, accumulate more information and thus adopt technology more rapidly. Similarly, Negatu and Parikh (1999) dwelt on the significant impact of technology transfer from the source to

the farmer through a link like extension agents and the central role played by the attributes of the technology and institutional circumstances play in technology adoption.

A study by Dontsop-Nguezet *et al*. (2011) on "Impact of improved rice technology on income and poverty among rice farming households in Nigeria" using the Local Average Treatment Effect (LATE) Approach, found a robust positive and significant impact of NERICA (New Rice for Africa) variety adoption on farm household income and welfare, measured by per capita expenditure and poverty reduction. Specifically, the empirical results suggest that adoption of NERICA varieties raises household per capita expenditure and income by an average of ₦4,739.96 and N63,771'94 per cropping season respectively. Cunguara and Darnhofer (2011) held that, "distinguishing between households based on propensity score quintiles using improved technologies, especially improved maize seeds and tractors, significantly increased the income of those households who had better market access" in rural Mozambique.

"Adoption of improved agricultural technologies has a significant positive impact on crop income, although the impact on consumption expenditure is mixed" (Asfaw, 2010). Uaiene (2004) from his study on "Maize and sorghum technologies and the effects of marketing strategies on farmers' income in Mozambique", using "the farm household model" to evaluate the potential impacts of the improved technologies with or without marketing strategies to address the constraints of low output prices, found that, "farm household income increases 58% with the introduction of inventory credit with new technologies as a result of maize intensification. A strategy to moderate price collapse between years due to inelastic demand and good weather combined with

storage and inventory credit increases farm income by 71%. The combination of all marketing strategies and new maize technologies increase the average farmer's household income by 81%."

## 2.8 Knowledge Gap and Link with the Present Study

Findings from many adoption and impact studies showed very low levels and rates of technology adoption with attendant low impact. This study was based on the innovation systems approach, where the farmers were major stakeholders in the conception and implementation of the improved crop production practices introduced with the goal of increasing their acceptance, therefore high adoption. Findings from this study will provide avalanche of information and data on adoption and impact of maize-cowpea/soybean and sorghum-cowpea/soybean crop production practices in the Sudan Savannah agro-ecological zone of Nigeria, thereby providing useful materials for scientists and researchers. The findings from this research will also contribute immensely to the pool of literature on research methodologies for development.

## 2.9 Socio-economic Characteristics of Farming Households

Noorivandi *et al*. (2009) from their study on the socio-economic characteristics of farmers regarding adoption of sustainable soil management by wheat farmers of Modares Watershed Region of Khuzestan Province, Iran found out that there was a significant correlation between socio-economic characteristics such as income, land size, level of mechanization, social participation, social status, crop yield, rate of loan, and sustainable soil management (SSM) Index. They also established that these were significant relationship between personal characteristics such as level of education,

technical knowledge, perception of farmers and sustainable soil management (SSM) Index.

Many studies carried out worldwide showed that there exists very close relationships between farmers' socio-economic characteristics and awareness or adoption of promoted farm practices. Adeniji (1996) in a study on "impact of mass media on adoption of agricultural innovation in Kaduna State, Nigeria" found out that, age, household size, formal education, farm size, income, cosmopolitanisms and community status were related to adoption. Voh (1979) and Atala (1980) found that socio-economic factors like age, household size, formal education, income, cosmopolitanism, and community status were related to adoption.

Eneh (2008) stated that income level, family size, social participation, extension contact, number of information sources used on introduced, improved practices and extent of awareness were significantly related to adoption. Joseph (2006) in a study on the impact of poverty reduction programmes in Nigeria found that not many young people engaged in poverty eradication programmes. He also found that most of the participants in poverty eradication programmes in Nigeria were middle aged men and women within the age brackets of 51 and 60 years. His study revealed that the overall average age of the rural dwellers was 60 years.

Agwu *et al.*(2008) in a research conducted on the adoption of improved agricultural technology disseminated via radio farmer programme by farmers in Enugu State, Nigeria found that 55% of the farmers have family size of between six to ten members. A study in Ghana by Emmanuel *et al*. (2006) revealed that farmers participating in

irrigation project had some level of formal education. The study also showed that most of the farmers fall between the ages of 35 and 45 years.

In a research conducted in Katsina State, northern Nigeria, Adekunle *et al*. (2006) found out that most farmers that participated in the project were male and involved in mixed farming. They also found out that farmers that belong to some organizations have better source of hygienic water than non members. Adesina and Baidu-Forson (1995) reported that older farmers may likely have more resources at their disposal that might make it more likely for them to try new technologies.

Jan (1986) observed that children in the rural areas engage in economic activities from a very early age, while urban children start usually later. He posited further that the age of retirements is generally open ended since very few people have access to a formal social security system. National Agricultural Extension and Research Liaison Services (1995) noted that the most pervasive characteristics of the rural youth that evidently transcend ethnic variation in Nigeria are the fact that they are introduced to agricultural activities at a tender age.

Adesehinwa and Okunlola (2000) in their study on socio-economic constraints to ruminant production in Ondo and Ekiti States, Nigeria, found that age and sex have no significant relationship with ruminant production. Maigida (2000) reported that 56% of the women involved in the Women in Agriculture programme (WIA) in Jos, Plateau State, Nigeria were in the age group of 20-40 years. Ogah (2004) in a study on economic analysis of small-scale oil palm processing in Benue State, Nigeria, found out that 89% (71) of the surveyed processors were female, while 11% (9) were males.

Udoh and Nyienakuna (2008) found out that in some African societies, assets like land and machines are mostly inherited by the male descendants. This means gender is a very important variable in agricultural productivity in terms of property acquisition. Oluwatayo *et al.* (2008) in their study of resource use efficiency of maize farmers in rural Nigeria found out that only 9% of women in their study areas owned farms. Onyenweaku and Ohajianya (2005), found a positive relationship between education, technical efficiency, and productivity in rice production in their study of swamp and upland rice farms in south eastern Nigeria.

Azam and Zoebisch (2009) in their study on socio-economic and land use factors involved in cropping system selection in north east Thailand found out that the highly educated farmers go for market oriented crops. Upton (1996) defined farming experience as the act of gaining knowledge through constant practicing of skill, which brings about specialization. In a study of socio-economic factors influencing the intensity of use of bio mass transfer in food crop production in western Kenya, Wanjiku *et al*. (2003) found out that the adopters were more educated and had more contact with the technology promoters more than non-adopters. Erbaugh (1999) maintained that adoption of improved technology and market integration are predicated on the differential possession of economic resources like land, labour and capital, in addition to socioeconomic and institutional factors, as well as the physical attribute of the technology itself.

## 2.10 Determinants of Escape from Poverty amongst Crop Farmers

Household composition, access to non-agricultural wage incomes and ownership of assets play important roles when determining movement in and out of poverty in rural Nicaragua (Kristian, 2011). A study conducted by Rashid and Rahman (2007) on the determinants of change in poverty status for 2,760 Bangladeshi households found that, while chronic illness, high health care expenses, loss of employment, loss of assets, and high debt burden were factors for households sliding back into poverty, diversification of income sources is the principal factor allowing for households to escape from poverty.

Empirical results from a study on "Escaping the Poverty Trap in Latin America: The Role of Family Factors" carried out by Enrique and Richardo (2001), indicated that the prevalence of intergenerational transmission of poverty in Latin America is strong, and that family factors played an important role in the educational achievement of poor children, hence on their lifetime income. Results for 16 Latin American countries showed that children in poverty with fewer siblings, more educated parents, higher household income, and living in urban areas are significantly more likely to complete secondary education. Completion of secondary education was taken as a threshold level of schooling at or above which a child of poverty should have a fair chance of escaping the poverty cycle in the 21$^{st}$ century.

## 2.11 Constraints to the Implementation of Agricultural Projects

Inadequate rural infrastructure affects the level of agricultural development. Cleaver (1993) found out that rural transport infrastructure is deficient in most developing countries. Incidents of agricultural produce rotting in remote parts of a country, for lack of roads, or impassable roads are commonplace (Lele and Adu-Nyako, 1991). Jalloh

and Dahniya (2001) stated that political turmoil in sub-Saharan Africa over the past two decades as a result of bad governance has provided the ground for both the formulation of ineffective agricultural programmes and strategies. According to Ekong (2003) constraints militating against adoption of recommended agricultural practices range from technology attributes such as cost, complexity, compatibility, visibility and divisibility to socio-economic, cultural and political factors among others.

Several factors have contributed, in varying degrees, to the underdevelopment of agriculture in most of the developing countries. Key challenges include the following (Lachaal, 2006):

(i) On the internal front, the past policy bias against agriculture in these countries along with other political constraints (including armed conflicts); physical constraints (including irregular weather patterns – drought, floods -, poorly developed infrastructure, isolation of agricultural regions); social constraints (including low levels of literacy and schooling, insufficient access to safe water for humans and livestock, low access to health care facilities, spread of malaria and HIV/AIDS); and financial constraints (including large external debts, low level of domestic savings, low public budgetary allocations to agriculture).

(ii) On the external front, extensive subsidies and border protection in many developed countries continue to block opportunities for those poor people who can best make their livings from farming and value added farm products.

The sector wide agricultural productivity constraints according to Philips *et al*. (2009) are: Poor agricultural pricing policies, low fertilizer use, poverty and women's limited access to inputs, low access to agricultural credit, poor funding and coordination of agricultural extension, land tenure system and land degradation, low and unstable investment in agricultural research, poor market access and marketing efficiency.

The adoption of agricultural technologies, especially of new maize-fertilizer based technologies is constrained by the low prices received by farmers in Mozambique. While urban and rural poor benefit from low agricultural prices, it is bound to harm the incentives of producers, the agricultural technology users, and ultimately affecting the momentum of agricultural growth" (Uaiene, 2004).

## 2.12 Innovation Systems Approach in Agriculture

The innovation system approach also provides a useful framework to explore linkages between stakeholders in agricultural innovation diffusion. Those actors belong to various companies, organisations, institutes, corporations, universities or research centres. They can be classified as private, public and NGO/semi-public depending on size, nature of funding sources and whether they operate as a service or profit-oriented enterprise. These actors can be local, regional, national or international in their scope (Sudath, 2006).

Innovation systems perspectives on agricultural research and technological change are fast becoming a popular approach to the study of how society generates, disseminates, and utilizes knowledge. The innovation systems literature represents a significant change from the conventional, linear approach to research and development by

providing an analytical framework that explores complex relationships among heterogeneous agents, social and economic institutions, and endogenously determined technological and institutional opportunities (Spielman, 2005). Recent empirical work extends the innovation systems approach from studies of national innovation systems in industrialized-country manufacturing to developing-country agriculture, and shifts the emphasis from a unidirectional technology transfer approach to a more complex, process based systems approach. This shift in perspective is appropriate for the study of developing-country agriculture because it captures the intricate relationships between diverse actors, processes of institutional learning and change, market and nonmarket institutions, public policy, poverty reduction, and socioeconomic development (Spielman, 2005). Early applications of the innovation systems framework to developing-country agriculture suggest opportunities for more intensive and extensive analysis. There is ample scope for empirical studies to make greater use of the theoretical content available in the literature, and to employ more diverse methodologies, both qualitative and quantitative. Further, there is room to improve the relevance of empirical studies to the analysis of public policies that support science, technology, and innovation, as well as to policies that promote poverty reduction and economic growth (Spielman, 2005).

# CHAPTER 3

# METHODOLOGY

## 3.1 The Study Area

This study was conducted in Katsina State of Nigeria, which covers the Sudan-Sahel ecology of the Country. It is bounded to the west by Zamfara State, south by Kaduna State, east by Jigawa and Kano States and north by the Republic of Niger (Figures 1 & 2). The State experiences its lowest temperature during harmattan season which is between November and February which time the weather is cool, windy, very dry and dusty. The average annual rainfall ranges from 25.40-38.10 millimetres with highest rainfall usually recorded in August. Katsina State has a projected population of 6,719,390 people in 2011 at 3.2% annual growth rate of 5,792,578 people in the 2006 National Population Census (FGN Gazette, 2007). The State has 34 Local Government Areas.

Figure 1. Map of Nigeria showing Katsina state

This report considers the process of IP formation and hence only the IP communities and not the counterfactuals, described in ii) and iii) above.

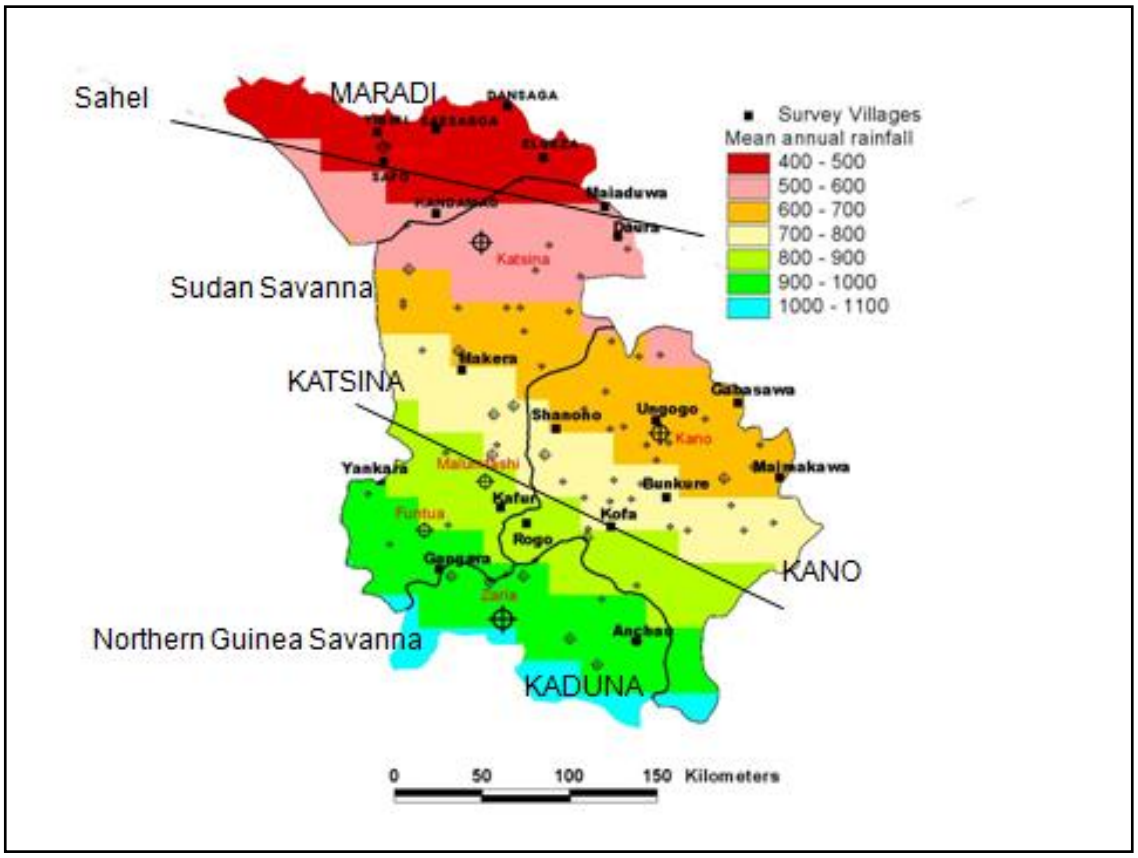


**Figure 2:** Map of the Kano-Katsina-Maradi PLS

In order to contribute to the Sub-Sahara Africa Challenge Programme proof of the concept of Integrated Agricultural Research for Development, the Kano- Katsina-Maradi Sudan Savannah task force set up and monitored four innovation platforms (1Ps), two each in Kano and Katsina States representing the Sudan Savannah (SS) zone of Nigeria. This study was carried out in Katsina State, Nigeria.

The maize-legume systems IP was in Musawa LGA, Katsina State. The LGA is in the southern part of the state. The five selected communities for the project in Musawa LGA were: Tabanni, Gin-Gin, Bakam, Yarkanya and Jikamshi, all situated within 30km

radius of the LGA headquarter and 110km radius from Katsina, the State capital. The Counterfactual LGA for this Innovation Platform (IP) was Dan Musa LGA, Katsina State.

The sorghum-legume systems IP was in Safana LGA, Katsina State. Safana LGA is in the northern part of the state. The five communities selected for the project in the LGA were: DogonRuwa, Kanbiri, Kunamawa A, Kunamawa B and Mai Jura, all located within the radius of six kilometres to the LGA headquarter and 114km to Katsina the state capital. The two tribal groups in the communities' are Hausa and Fulani. The population's gender distribution is about 45% male and 55% female. The Counterfactual LGA for this Innovation Platform (IP) is Ingawa LGA, Katsina State.

In order to contribute to the proof of concept about IAR4D, the SS taskforce has two sets of counterfactuals for each IP. The counterfactual villages include those with no current Research and Development (R & D) activities and those with some R & D activities. Each IP covers five villages within a local government. Ten counterfactual villages (5 with no R & D activities and 5 with some R & D activities) have also been chosen for comparison purposes. For each IP and its counterfactuals, innovation development, knowledge increase and information sharing among IP members were being monitored and accessed. Furthermore, for each IP, information sharing and technology uptake within the communities were assessed using a random sample of 10 farmers per village.

In literature, in assessing the effects of agricultural research, the "factual" describes the state or situation of the presence of technological change from the adoption and diffusion of new crop cultivars or crop management techniques; the " counterfactual" refers to the

situation in the absence of technology (Kerr and Kolavalli, 1999; Meinzen-Dick., *et al*. 2007). Methodological and conceptual challenges have long plagued attempts to define the two states and separate the effects of the technology per se from countervailing social, political, and economic changes that occurred simultaneously and may have been driven by similar underlying factors (Kerr and Kolavalli, 1999; Meinzen-Dick *et al*., 2007).

### 3.2 Sampling Procedure and Sample Size

The sampling design adopted for the study was multistage stratified random sampling. A two stage sampling design was followed; in the first stage, villages in the participating LGAs for intervention and non-participating LGAs for both conventional and clean LGAs were selected and then farmers sampled. The non-participating LGAs served as counterfactuals to intervention LGAs. The sample was also stratified, at the first stage between villages where there were on-going platform activities and villages without platform activities.

For each participating LGA the list of all the participating villages were made. The same was done for each non-participating LGAs. Five villages were selected from the list of participating (intervention) and non-participating (conventional and clean) LGAs randomly using a table of random numbers. In the second stage, the same procedures applied in the sampling of villages were also followed in selecting farmers' samples. From each of the sampled villages, lists of crop farmers were made with the assistance of Agricultural Development Project staff and then ten farmers selected using systematic random sampling method. Ten farmers were also selected using systematic random sampling method from the conventional and clean villages. The total sample

size was 300 and consisted of adopters (137) and non-adopters (163) as shown in Table 1.

Table 1: Distribution of respondents by LGAs, Villages and Treatments

| LGA | Villages | Treatment | Participating/non-participating | No. of respondents | Number of respondents that were adopters | Number of respondents that were Non-participating Adopters |
|---|---|---|---|---|---|---|
| Safana | Kunamawa A | Intervention | Participating | 10 | 10 | 0 |
| | Kanbiri | Intervention | Participating | 10 | 10 | 0 |
| | Dogon Ruwa | Intervention | Participating | 10 | 10 | 0 |
| | Mai Jaura | Intervention | Participating | 10 | 10 | 0 |
| | Kwamawa B | Intervention | Participating | 10 | 9 | 1 |
| Musawa | Jimkashi | Intervention | Participating | 10 | 10 | 0 |
| | Tabbani | Intervention | Participating | 10 | 10 | 0 |
| | Bakan | Intervention | Participating | 10 | 9 | 1 |
| | Yarkanya | Intervention | Participating | 10 | 9 | 1 |
| | Gin-Gin | Intervention | Participating | 10 | 9 | 1 |
| Dan | Garaji | Clean | Non- | 10 | 2 | 8 |
| | Barza | Clean | Non- | 10 | 1 | 9 |
| | Tasha kaura | Clean | Non- | 10 | 1 | 9 |
| | Chakau | Clean | Non- | 10 | 2 | 8 |
| | Yantumaki | Clean | Non- | 10 | 4 | 6 |
| | Sanawa | Convention | Non- | 10 | 2 | 8 |
| | Nasarawa | Convention | Non- | 10 | 2 | 8 |
| | Shema | Convention | Non- | 10 | 1 | 9 |
| | Shantalawa | Convention | Non- | 10 | 2 | 8 |
| | Karofi | Convention | Non- | 10 | 5 | 5 |
| Ingawa | Yandoma | Clean | Non- | 10 | 0 | 10 |
| | Kandawa | Clean | Non- | 10 | 0 | 10 |
| | Gamda | Clean | Non- | 10 | 0 | 10 |
| | Kurfeji | Clean | Non- | 10 | 1 | 9 |
| | Irawa | Clean | Non- | 10 | 2 | 8 |
| | Yargora | Convention | Non- | 10 | 3 | 7 |
| | Masibil | Convention | Non- | 10 | 0 | 10 |
| | Manomawa | Convention | Non- | 10 | 3 | 7 |
| | Shibdawa | Convention | Non- | 10 | 5 | 5 |
| | Gobirawa | Convention | Non- | 10 | 5 | 5 |
| **Total** | **30** | | | **300** | **137** | **163** |

### 3.3 Data collection method

The data were obtained through surveys of farm households in the project villages. The main instruments for data collection was structured questionnaire administered on households by trained enumerators under the supervision of Scientists from

International Institute of Tropical Agriculture (Kano Zonal Office), Scientists from Institute for Agricultural Research (Ahmadu Bello University Zaria) and the project task force. The sample frame was derived from four Local Government Areas in the State. In each State, a sample of households was selected by taking a sample of LGAs; a random sample of villages within each LGA; a random sample of households in each selected village. Finally, a household was retained in the sample if it belonged to one of the 30 villages selected within the clean, conventional or IP/action sites. Altogether, 10 households were randomly selected in each village giving a total of 300 households interviewed in the State.

### 3.4 Analytical Techniques

Descriptive statistics was used to achieve objectives (i) and (vii), Adoption index was used to achieve objective (ii), Logistic regression was used to achieve objective (iii). The double difference estimator was used to achieve objective (iv). Stochastic production function was used to achieve objective (v), while Probit regression analysis was used to achieve objective (vi).

#### 3.4.1 Descriptive statistics

Descriptive statistics such as percentages, frequencies, means, standard deviation were used.

#### 3.4.2 Adoption rate

Adoption rate is given by:

$$B_v = \frac{\sum_{i=1}^{n} R_{vi}}{\sum_{i}^{n} R_T} \ldots\ldots \qquad (12)$$

Where:

$B_v$ = the adoption rate for the crop variety v.

$R_{vi}$ = land area grown to crop variety v by farmer i (i = 1, 2, ---137)

RT = total land area cropped by farmer i.

### 3.4.3 The logit model

The effect of a set of explanatory variables on adoption of Sudan Savannah Task Force improved crop production practices in Nigeria was specified using the following expression:

$$Adoption = f(\times_1 \times_2 \times_3 \times_4 \times_5 \cdots\cdots \times_n) \cdots\cdots (13) — Implicit\ form$$

$$Y = B_0 + B_1 \times_1 + B_2 \times_2 + B_3 \times_3 + B_4 \times_4 \cdots\cdots B_{10} \times_{10} + \mu \cdots\cdots (14) - Explicit\ form$$

Where:

Y = a dichotomous response variable such that, Y = 1 if farmers adopt the SSTF CP practices in the Sudan savannah, Nigeria and 0 if farmers does not. Farmers that adopted 50% or more from the package were termed adopters of the SSTF crop production practices.

$\times_1$ = Age of the household head (Years)

$\times_2$ = Household size

$\times_3$ = Number of years of experience in farming by the household head

$\times_4$ = Farm size of the household

$\times_5$ = Years of formal education of the household head

$\times_6$ = Amount of credit used

$\times_7$ = Extension contact (number of extension visits per annum)

$\times_8$ = Farm income (₦ per annum)

$\times_9$ = Market distance in kilometre from the farmers house to the nearest urban market

$\times_{10}$ = Land ownership (dummy; 1 if hired and 0 if otherwise)

u = disturbance term or error term which is normally indicated as zero mean and variance

$B_1, B_2 \text{------} B_{10}$ are the coefficients of independent variables.

The coefficient of the regression model was estimated using the maximum likelihood estimating method.

### 3.4.4 The double difference estimator

To use this model, information on both adopters of SSTF crop production practices and non- adopters were required for before and after programme intervention. The Verners model adapted for this study was specified in equation (15).

$$DD = \left[\left(\frac{1}{N_A}\sum_{1=i}^{N_A}(\bar{Y}_1^A - \bar{Y}_0^A)\right) - \left(\frac{1}{N_{NA}}\sum_{1=j}^{N_{NA}}(\bar{Y}_1^{NA} - \bar{Y}_0^{NA})\right)\right] \ldots \qquad (15)$$

Where,

$\bar{Y}_0^A$ = average income (₦)of the adopters before the intervention,

$\bar{Y}_1^A$ =average income (₦) of the adopters after the intervention,

$\bar{Y}_0^{NA}$ =average income (₦) of the non-adopters before the intervention,

$\bar{Y}_1^{NA}$ =average income (₦) of the non-adopters after the intervention,

$N_A$ = number of adopters

$N_{NA}$ = number of non-adopters

DD = the difference between the average changes in the income for the adopters and non-adopters.

It is common to find difference in difference estimators presented in a table format and for this study, the format is presented in (Table 2).

Table 2: Double difference estimate of the impact of adoption of SSTF improved crop production practices on farmers' income

| | **Pre Intervention** | **Post Intervention** | **Difference between periods** |
|---|---|---|---|
| Adopters | $\bar{Y}_0^A$ | $\bar{Y}_1^A$ | $\bar{Y}_1^A - \bar{Y}_0^A$ |
| Non-adopters | $\bar{Y}_0^{NA}$ | $\bar{Y}_1^{NA}$ | $\bar{Y}_1^{NA} - \bar{Y}_0^{NA}$ |
| Difference between groups | $\bar{Y}_0^A - \bar{Y}_0^{NA}$ | $\bar{Y}_1^A - \bar{Y}_1^{NA}$ | $\bar{Y}_1^A - \bar{Y}_1^{NA} - (\bar{Y}_0^A - \bar{Y}_0^{NA})$ |

The test of hypothesis was examined using t-test as;

$$t = \frac{\bar{X}_1 - \bar{X}_2}{SE} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

$$Coefficient\ of\ Variation\ (CV) = \frac{Standard\ deviation}{Mean}$$

$$SE_x = \frac{Stddev_x}{\sqrt{N}_x}$$

Where:

$SE$ =Standard error

$\times_1$ and $\times_2$ are sample means of the two groups

$Std$ =Std deviation for a group

$N$ =Sample size for a group

### 3.4.5 Cobb-Douglass frontier production function

The production technology of the farmer was assumed to be specified by the Cobb-Douglass frontier production function as described by Tadesse and Krishnamoorthy (1997). The function was described as:

$$\text{Ln}\, Yi = B_0 + B_1 \text{Ln}\times_1 + B_2 \text{Ln}\times_2 + B_3 \text{Ln}\times_3 + B_4 \text{Ln}\times_4 + V_i - \mu_i \cdots\cdots (17)$$

Subscript i refer to the i$^{th}$ farmer in the sample

Ln Denote the natural logarithm (base e)

$Y$ =Value of the output (Crop in Naira)

$\times_1$=Farm size (ha)

$\times_2$=Seed in grain equivalent (kg) because we have up to five crops

$\times_3$=Labour (man-hour)

$\times_4$=Fertilizer (kg)

$V_i$ = Error term which are assumed iid (independent and identically distributed) with mean zero and constant variance and independent of $\mu_i$

$\mu_i$ = Non-negative random variable associated with technical inefficiency in production

The technical inefficiency effects μ is defined by:

$$\mu = Z_0 + \hat{O}_1 Z_{1i} + \hat{O}_2 Z_{2i} + \hat{O}_3 Z_{3i} + \hat{O}_4 Z_{4i} + \hat{O}_5 Z_{5i} + \hat{O}_6 Z_{6i} \cdots\cdots (18)$$

Where: $Z_0$,$Z_1$, $Z_2$, $Z_3$,$Z_4$,$Z_5$ and $Z_6$ represents, intercept, age, household size, years of experience in farming, educational level, extension contact and annual income respectively. These were included in the model to indicate their possible influence on the technical efficiencies of the farmers.

### 3.4.6 Probit regression analysis

Probit regression analysis was used to ascertain determinants of propensity to escape from poverty by the sampled crop farmers. Since farmers plant a number of crops on one plot, the total value of production per ha in Naira as an average on-farm annual income was divided by 365 days of a year and converted into binary response variable. A crop farmer was scored 1 if its per capita income was above the international poverty line of ₦190 per day (equivalent to US$1.25 per day) and 0 if otherwise. This was regressed on hypothesized drivers of propensity to escape from poverty such as farmers' age, years of crop production experience, farm size in hectare, number of years of schooling, amount of

credit used (₦), extension visit dummy, market distance (km), land tenure dummy, and adoption.

The model is implicitly stated as:

$$Y = \propto_0 + \propto_j \sum_{j}^{10} \times_j + e_i \ldots\ldots\ldots (19)$$

Where:

$Y$ =The poverty status dummy (poor=1, 0= otherwise).

$j$ = 1...10

Where:

$\times_1$=Age of farmers in years,

$\times_2$= Household size

$\times_3$=Years of farming experience

$\times_4$=Farm size in hectare

$\times_5$=Years of schooling

$\times_6$= Amount of credit used (Naira)

$\times_7$= Extension visit

$\times_8$= Distance to market (kilometre)

$\times_9$= Land tenure (ownership structure of land as it affects probability to escape from poverty)

$\times_{10}$= Adoption (average difference between adopters and non-adopters for the probability to escape from poverty)

$e_i$ = Stochastic error term

# CHAPTER 4

# RESULTS AND DISCUSSION

## 4.1 Socio-economic Characteristics of the Crop Farmers

In this section, basic socio-economic characteristics of crop farmers like age, farm size, crop farming experience, educational level, household size, sources of farm labour, marital status, annual income, amount and sources of credit, contact with extension discussed. These characteristics are imperative to the understanding of the crop farmers, as they have effects on the farmers' behaviour and adoption of the SSTF improved crop production practices extended to them (or available) in the farming environment in which they operate.

### 4.1.1 Age of respondents

Age is a very important variable that determines the degree of active involvement of an individual in crop production. This is particularly true of the traditional agricultural system of the developing countries where most of the farm operations are performed manually using crude and simple farm implements. Table 3 shows the age distribution of the farmers. The study showed that 51% of the crop farmers were within the active age bracket, which ranged between 20 and 49 years. However, only about 3% were more than 69 years old. The mean age of the farmers was 49.83 years. This age can positively influence the adoption of SSTF improved crop production practices, which invariably could influence the level of crop production. Loren (1984) stated that the middle aged farmers appear to be the most productive.

Table 3: Distribution of crop farmers based on age

| Age (years) | Frequency | Percentage |
|---|---|---|
| 20 – 29 | 24 | 8.00 |
| 30 – 39 | 32 | 10.67 |
| 40 – 49 | 97 | 32.33 |
| 50 – 59 | 116 | 38.67 |
| 60 – 69 | 23 | 7.67 |
| ≥ 70 | 8 | 2.67 |
| **Total** | **300** | **100** |

**Mean: 49.83 years**

### 4.1.2 Farm size

The farm size of the crop farmers in the study area ranges between about 0.7 hectares to about 12.3 hectares, with 2.8 hectares as the mean. Sampled crop farmers were grouped under six sizes of farm holdings as shown in Table 4. From the table, about 88% of the farmers had farm land ranging from less than 1 hectare to 3 hectares, 42% had between 2.1 hectares to 4.0 hectares, and 15% had between 4.1 hectares and 6.0 hectares, while 10% had between 6.1 to 10 hectares. The above findings showed that crop production in the study area was largely practiced by small-scale farmers.

Table 4: Distribution of the crop farmers according to farm size

| Farm Size (Hectare) | Frequency | Percentage |
|---|---|---|
| ≤ 1.0 | 47 | 15.67 |

| | | |
|---|---|---|
| 1.1 – 2.0 | 68 | 22.67 |
| 2.1 – 3.0 | 148 | 49.33 |
| 3.1 - 4.0 | 23 | 7.67 |
| 4.1 – 5.0 | 9 | 3.00 |
| ≥ 5.1 | 5 | 1.67 |
| **Total** | **300** | **100** |

**Mean : 2.8 hectares**

### 4.1.3 Years of crop production experience

Experience in agricultural production and processing can raise productivity (Johnson, 1990). The process of learning by doing makes farmers acquire knowledge and skills in their production. This is called gained experience. It measures the duration an individual farmer was involved in crop production and thus interpreted as the more the number of years of crop production by a farmer, the greater the experience gained. This automatically influences individual's understanding and adoption of the improved technologies. The mean years of experience among the sampled crop farmers in the study area was over 27 years.

The farming experience of the farmers is shown in Table 5. The result indicated that over 65% of the farmers have been producing crop for over 22 years. On the other hand, only 4% had crop production experience of less than 12 years.

Table 5: Distribution of crop farmers based on years of crop production experience

| **Farming Experience** | **Frequency** | **Percentage** |
|---|---|---|
| ≤ 11 | 12 | 4.00 |
| 12 – 16 | 35 | 11.67 |
| 17 – 21 | 57 | 19.00 |
| 22 – 26 | 62 | 20.67 |
| 27 – 35 | 110 | 36.67 |

| | | |
|---|---|---|
| ≥ 32 | 24 | 8.00 |
| **Total** | **300** | **100** |

**Mean : 27 years**

### 4.1.4 Educational level

Among the major constraints that militate against the awareness and adoption of improved technology in the agricultural sector is illiteracy (Umar, 2005; Saka and Lawal, 2009). One of the most important farmer level factor that can influence the adoption of improved technology and hence productivity of crops is the level of education of farmers.

The educational level of farmers is reported in Table 6. From the result, 37% of the crop farmers had Arabic/Quranic education. This is due to the fact that the study area is a predominantly Muslim community where Islamic knowledge is given a high priority. Over 23% and 3% of the farmers had primary education and post secondary education respectively. From the study, all the respondents have one form of education or the other. This high level of literacy in the study area implies that the respondents may be ready to accept and adopt innovations brought to them.

Table 6: Distribution of the crop farmers according to educational level

| **Education Level** | **Frequency** | **Percentage** |
|---|---|---|
| Arabic/Quranic education | 111 | 37.00 |
| Adult education | 63 | 21.00 |
| Primary school education | 70 | 23.33 |
| Secondary school education | 46 | 15.33 |
| Post secondary school education | 10 | 3.33 |
| **Total** | **300** | **100** |

### 4.1.5 Household size

A household is defined in this research as the number of persons living together and eating from the same pot. The household size determines the available human labour force that can be employed in carrying out crop production activities. The major source of human labour supply in traditional agricultural production, which is labour intensive, is family labour.

The household size distribution of crop farmers is shown in Table 7. Among the farmers, 53% were in the range of 11 and 20 persons in their households, while only about 4% had more than 25 persons in their households. The mean household size was 12.9 persons, implying that this could be a source of cheap family labour among the farmers household.

Table 7: Distribution of crop farmers based on household size

| **Household Size** | **Frequency** | **Percentage** |
|---|---|---|
| 1 – 5 | 36 | 10.00 |
| 6 – 10 | 76 | 25.33 |
| 11 – 15 | 127 | 42.33 |
| 16 – 20 | 32 | 10.67 |
| 21 – 25 | 24 | 8.00 |
| ≥ 26 | 11 | 3.67 |
| **Total** | **300** | **100** |

**Mean : 12.9 persons**

### 4.1.6 Source of labour

The crop farmers were distributed based on the source of human labour employed in their crop production process (Table 8). The result in the table indicated that about 49% of the farmers used only family labour, while about 15% and 37% employed hired labour, and combination of family and hired labour respectively. This probably confirmed the assertion in 4.1.5 (of the average household size of 12.9 persons being source of cheap family labour among the farmers' households).

Table 8: Distribution of crop farmers according to source of labour

| Source of Labour | Frequency | Percentage |
|---|---|---|
| Family only | 146 | 48.67 |
| Hired only | 44 | 14.67 |
| Family & Hired | 110 | 36.67 |
| **Total** | **300** | **100** |

### 4.1.7 Land tenure system

Land is one of the important factors of production in agricultural industry. Land tenure system was investigated among crop farmers in the study area and the result is in Table 9. The farmers were asked to identify one major means of land acquisition. The result showed that about 58% of the crop farmers obtained their farm lands through inheritance, 19% acquired their land through purchase, and 13% of the farmers hired their crop lands, while 10% have reported to have gotten their crop lands through gift (Table 9). Normally, the type of land tenure system serve as a basis for future land security and hence the ability to stabilize production. Land tenure by purchase could be a more secured method of acquiring land for commercial productive activities. The

Inheritance land tenure system usually leads to land fragmentation resulting into smaller and uneconomic farm sizes common in traditional agriculture in the developing countries

Table 9: Distribution of the crop farmers according to land tenure system

| Nature of Land Acquisition | Frequency | Percentage |
|---|---|---|
| Inheritance | 173 | 57.67 |
| Purchase | 57 | 19.00 |
| Hired | 39 | 13.00 |
| Gift | 31 | 10.33 |
| **Total** | **300** | **100** |

### 4.1.8 Types of farm implements used

Table 10 showed the types of implements employed by the crop farmers in the study area. Among the farmers, 63% used traditional hand implements such as hoes, cutlasses and rakes in their crop farm operations, as is common in peasant agriculture. The result further showed that 21% of the farmers do combine both the hand implements with animal drawn traction in carrying out their farm operations. Farm animals such as bulls and donkeys were usually used for traction in the crop production sector. Crop residues were use to feed such animals.Additionally,16% combined the use of traditional implements and tractor drawn implements in performing crop production activities. This indicated that crop production industry in the study area was not mechanized. Tractor services were only employed during land clearing and preparations.

Table 10: Distribution of crop farmers based on types of farm implements used

| Type of Implement | Frequency | Percentage |
|---|---|---|
| Hand implements | 189 | 63.00 |
| Hand implements /Animal traction | 63 | 21.00 |
| Hand implements /Tractor | 48 | 16.00 |
| **Total** | **300** | **100** |

### 4.1.9 Amount of credit used

The importance of agricultural credit in production cannot be over emphasized. It increases the purchasing power of farmers and adoption of improved technology. The study observed that the crop farmers in the study area used different amounts of credit to finance their production activities. The mean amount of credit borrowed by the respondents was ₦35, 000. About 19% of the crop farmers were observed to borrow less than ₦10, 000 per production season. Some 80% borrowed between ₦10, 000 and ₦49,000. Only about 2% borrowed more than ₦49, 000 (Table 11).

Table 11:Distribution of crop farmers according to amount of credit received

| **Amount (₦)** | **Frequency** | **Percentage** |
|---|---|---|
| < 10,000 | 56 | 18.67 |
| 10,000 – 19,000 | 43 | 14.33 |
| 20,000 – 29,000 | 79 | 26.33 |
| 30,000 – 39,000 | 92 | 30.67 |
| 40,000 – 49,000 | 25 | 8.33 |
| ≥ 50,000 | 5 | 1.67 |
| **Total** | **300** | **100** |

**Mean : ₦35, 000**

### 4.1.10 Source of agricultural credit

Fund is one of the indispensable components of any production process. Sometimes, success and failure of an agricultural business is largely affected by the ability of the farmer or firm to secure fund to provide the necessary inputs when required, at the appropriate quantity.

Farmers in the study area used multiple sources to finance their crop production (Table 12). About 42% of the crop farmers in the study area obtained their agricultural credit from informal savings/credit groups. Probably, this may be due to zero interest charges and non requirement of collaterals involved in the source. Other important informal sources of credit in the study area were relatives/family, input/output dealers, money lenders, NGOs. A government credit scheme and banks were the only formal credit sources, and the least sources of agricultural credit with only about 4% each (Table 12). This means that crop farmers in the study area sourced their credits mainly from informal sources.

Table 12:Distribution of the crop farmers according to their source of agricultural credit

| **Source** | **Frequency** | **Percentage** |
|---|---|---|
| Relative/Friends | 75 | 25.00 |
| Money lenders | 22 | 7.33 |
| NGO | 23 | 7.67 |
| Input/output dealers | 31 | 10.33 |
| Government credit schemes | 11 | 3.67 |
| Informal savings/credit group | 126 | 42.00 |
| Bank or Micro-finance institution | 12 | 4.00 |
| **Total** | **300** | **100** |

### 4.1.11 Marital status

Another important socio-economic variable that influences an individual's commitment to a particular business venture is the marital status. Traditionally, married men are considered responsible and bread winners of their family in African societies. They are expected to be fully committed in their crop farming activities to satisfy the subsistence needs of their family and market the surplus.

Table 13 showed the distribution of crop farmers by marital status. Greater percentage of the farmers (89%) were married, while only a little over 9% were single. This can be attributed to the culture of the people in the study area which encourages early marriage. The implication here is that the farms would have greater attention from responsible members of the family. Its disadvantage is that, it leads to land fragmentation as the new household would have its own piece of land separated from the whole household's farm land.

Table 13:Distribution of the crop farmers according to their marital status

| Marital Status | Frequency | Percentage |
|---|---|---|
| Married | 267 | 89.00 |
| Single | 28 | 9.33 |
| Divorced | 5 | 1.67 |
| Total | 300 | 100 |

### 4.1.12 Membership of farmers' cooperative society

Cooperatives are usually formed by the members to enjoy the advantage of economies of scale in production, processing and marketing of agricultural produce. Members also benefit from trainings and education in modern agricultural practices and use of agricultural inputs.

In the study area, the farmers have joined farmers' cooperative societies at varying period of time as indicated in Table 14. About 28% of the respondent did not belong to any farmers' cooperative society, while about 68% were members and have spent between six to 20 years in farmers' cooperative societies. Only about 2% had membership that exceeded 20 years, while the average membership was 12 years. This

implies that about 72% of the crop farmers benefited from trainings and education in the use of modern agricultural practices and access to agricultural inputs which were some of the benefits derived from being members of Farmers' Cooperative.

Table 14: Distribution of the farmers according to years spent as members in farmers' cooperative

| Years of Membership | Frequency | Percentage |
|---|---|---|
| 0 | 83 | 27.67 |
| 1 – 5 | 9 | 3.00 |
| 6 – 10 | 27 | 9.00 |
| 11 – 15 | 136 | 45.33 |
| 16 – 20 | 40 | 13.33 |
| ≥ 21 | 5 | 1.67 |
| **Total** | **300** | **100** |

**Mean : 12 years**

### 4.1.13 Annual farm income

The gross annual farm income of the farmers is shown in Table 15. Most of the farmers (34%) earned gross annual income of ₦500, 000 – ₦740, 000. However, about 2% had income that exceeded ₦1, 000,000 annually, while the mean gross annual income was ₦512, 000.

Table 15: Distribution of the crop farmers according to their annual income (₦)

| Annual income (₦) from crop production | Frequency | Percentage |
|---|---|---|
| ≤ 240,000 | 56 | 18.67 |
| 250,000 – 490,000 | 89 | 29.67 |
| 500,000 – 740,000 | 102 | 34.00 |
| 750,000 – 990,000 | 47 | 15.67 |
| ≥ 1,000,000 | 6 | 2.00 |
| **Total** | **300** | **100** |

**Mean : ₦512, 000**

### 4.1.14 Access to SSTF improved crop production practices

Improved production technology can only be adopted if it is available and accessible to farmers. The accessibility of SSTF recommended crop practices among the sampled farmers were investigated and the result is shown in Table 16. Majority of the

respondents (77%) had access to those technologies, while 23% did not. Among the farmers that had access to SSTF crop technologies, 59.31% were found to be adopters, which is relatively high given the problems with adoption of technologies among farmers. Dontsop-Nguezet *et al*. (2010) found the actually observed adoption rate of NERICA in Nigeria to be 20%.

Table 16: Crop farmers' access to SSTF improved crop production practices

| **Access to SSTF crop producing technologies** | **Frequency** | **Percentage** |
|---|---|---|
| Has access | 231 | 77.00 |
| Has no access | 69 | 23.00 |
| **Total** | **300** | **100** |

### 4. 1. 15 Test of mean differences in between adopters and non- adopters

T-test was run to determine the differences in socio-economic characteristics between adopters and non- adopters of SSTF improved crop production practices. Comparison was made on age, household size, number of years of schooling, farm size, amount of credit used, and number of years of cooperative membership (17). The results of the T-test showed that there were significant differences between adopters and non- adopters of SSTF recommended crop production practices in relation to number of years spent in farmers' cooperatives and amount of credit utilized in crop production at 1% and 10% level of significance respectively. The adopters used more credits for their farming activities than the non-adopters because they were more in the membership of farmers' cooperative societies. Similarly, there was also a significant difference between adopters and non-adopters of SSTF recommended crop production practices in relation to number of years spent in schooling at 10% level. Education is an important factor that influences the adoption of improved technology and productivity of crops.

Table 17: Test of Mean Differences in some Socio-economic Characteristics between adopters and non-adopters

| Characteristics | Adopters n=137 | Non-Adopters n=163 | Total n=300 | Difference test |
|---|---|---|---|---|
| Age | 49.6 | 50.3 | 49.83 | -0.023 |
| | (0.62) | (0.64) | (0.52) | (1.32) |
| Household size | 12.3 | 13.1 | 12.9 | -1.6 |
| | (1.31) | (1.04) | (1.22) | (1.18) |
| Number of years in schooling | 11.2 | 2.7 | 6.02 | 9.05 |
| | (2.91) | (2.11) | (2.61) | (2.90)* |
| Number of years in crop production | 25.22 | 31.03 | 27.26 | 6.77 |
| | (3.88) | (3.99) | (3.43) | (3.89) |
| Farm size (ha) | 6.31 | 6.20 | 6.29 | 0.45 |
| | (0.11) | (0.72) | (0.33) | (0.38) |
| Amount of credit used (₦) | 55,000 | 11,350 | 35,000 | 31,000 |
| | (8,990) | (11,120) | (9,760) | (10,896)* |
| Years of membership in cooperative | 13 | 7 | 12 | 6 |
| | (3.091) | 3.060 | (3.127) | (3.014)*** |

*** P<0.01, *P<0.10

Figures in parentheses are the standard errors. DIFF. Is difference

### 4.2 The Rate of Adoption of SSTF Improved Crop Production Practices

The estimated adoption rate of the SSTF recommended crop production practices identified by the crop farmers is shown in Table 18. The result shows that about 24% of respondents adopted the new crop varieties' technology, with adoption rate ranging from 2% to 100%, with a mean of 51%. About 29% of the crop farmers adopted the inorganic fertilizer burying technology with a mean adoption rate of 56%. Pesticide application technology was adopted by about 26% of the farmers with the mean adoption rate of 61%. The adoption rate for the recommended plant row spacing technology was estimated to be 51%. The overall adoption rate for SSTF improved crop production practices in the study area ranges from 12% to 97% with a mean of 55%, implying that the sampled crop farmers have put large proportion of their land, with a mean of about 3 hectares, into adoption of such technologies brought to them by SSTF.

Table 18: A summary of the adoption rate of SSTF improved crop production practices in the study area

| Technology Adopted | Frequency | % | Average land Area used (ha) | Adoption Rate | | |
|---|---|---|---|---|---|---|
| | | | | Mean | Min | Max |
| New crop varieties | 56 | 24.24 | 2.71 | 0.51 | 0.02 | 1.00 |
| Burying of fertilizer | 68 | 29.44 | 3.57 | 0.56 | 0.11 | 1.00 |
| Plant row spacing | 48 | 20.78 | 1.71 | 0.51 | 0.01 | 1.00 |
| Pesticide application | 59 | 25.54 | 2.69 | 0.61 | 0.34 | 0.88 |
| **Total** | **231*** | **100** | **2.67** | **0.55** | **0.12** | **0.97** |

**Note: * multiple responses allowed**

For the new crop variety/technology, the estimated mean adoption rates for the introduced new varieties of maize, sorghum, cowpea, millet and groundnut in the study area were: 67%, 46%, 54%, 46% and 52%, respectively as shown in Table 19. The result shows that about 34% of the farmers adopted new maize varieties, about 31% of the farmers adopted new sorghum varieties, about 27% of the farmers adopted new cowpea varieties, and about 22% of the farmers adopted new millet varieties, while about 27% of the farmers adopted the new groundnut varieties. The mean land area put into the cultivation of maize, sorghum, cowpea, millet and groundnut were about: 3ha, 3ha, 1ha, 1ha and 2ha, respectively. Putting these large land areas into the cultivation of these new crop varieties led to increased productivity by farmers. Farmers income also increased tremendously, thereby enhancing their food security status. This finding was validated by the work of Ofor, *et al*. (2009) which states that in spite of the importance of maize and guinea corn as sources of food for human consumption, their production is concentrated in the hands of peasant farmers whose average hectare is very small, approximately 0.5-1.0 hectare per farmer.

Table 19: The adoption rate of SSTF improved crop production practices in crops' production in the study area

| Technology Adopted | Frequency | % | Average Land area used (ha) | Adoption Rate | | |
|---|---|---|---|---|---|---|
| | | | | Mean | Min | Max |
| **Maize** | | | | | | |
| New crop varieties | 56 | 33.94 | 2.78 | 0.67 | 0.33 | 1.00 |
| Burying of fertilizer | 61 | 36.97 | 5.06 | 0.62 | 0.24 | 1.00 |
| Plant row spacing | 48 | 29.09 | 1.53 | 0.39 | 0.11 | 0.66 |
| **Total** | **165*** | **100** | **3.11** | **0.56** | **0.23** | **0.89** |
| **Sorghum** | | | | | | |
| New crop varieties | 47 | 30.52 | 3.17 | 0.46 | 0.02 | 0.89 |
| Burying of fertilizer | 68 | 44.16 | 5.66 | 0.49 | 0.22 | 0.75 |
| Plant row spacing | 39 | 25.33 | 2.10 | 0.32 | 0.01 | 0.62 |
| **Total** | **154*** | **100** | **3.63** | **0.43** | **0.08** | **0.76** |
| **Cowpea** | | | | | | |
| New crop varieties | 43 | 27.22 | 1.43 | 0.54 | 0.20 | 0.88 |
| Burying of fertilizer | 32 | 20.25 | 1.21 | 0.18 | 0.11 | 0.25 |
| Plant row spacing | 24 | 15.19 | 1.01 | 0.45 | 0.05 | 0.84 |
| Pesticide application | 59 | 37.34 | 2.69 | 0.61 | 0.34 | 0.88 |
| **Total** | **158*** | **100** | **1.59** | **0.45** | **0.18** | **0.71** |
| **Millet** | | | | | | |
| New crop varieties | 28 | 21.71 | 1.22 | 0.46 | 0.03 | 0.89 |
| Burying of fertilizer | 66 | 51.16 | 1.01 | 0.56 | 0.40 | 0.74 |
| Plant row spacing | 35 | 27.13 | 1.11 | 0.37 | 0.06 | 0.66 |
| **Total** | **129*** | **100** | **1.11** | **0.46** | **0.16** | **0.76** |
| **Groundnut** | | | | | | |
| New crop varieties | 39 | 27.08 | 2.23 | 0.52 | 0.03 | 1.00 |
| Burying of fertilizer | 68 | 47.22 | 1.34 | 0.56 | 0.22 | 0.89 |
| Plant row spacing | 37 | 25.69 | 1.09 | 0.67 | 0.34 | 1.00 |
| **Total** | **144*** | **100** | **1.55** | **0.59** | **0.20** | **0.96** |

**Note: * multiple responses allowed**

### 4.3 Factors Affecting Adoption of Recommended SSTF Crop Production Practices

The results from the logit model used to identify the factors affecting the adoption of recommended SSTF crop production practices in the study area using maximum likelihood estimation are presented in Table 20.

The chi-square value of 103.42 was significant (P< 0.01) and the model accounted for over 66% of the variations observed among adopters of recommended SSTF crop

production practices. This implies that the model was well-specified and the explanatory variables in the model collectively explained the farmers' decision regarding the adoption of recommended SSTF crop production practices. The decision to adopt such improved practices in the study area was observed to be influenced by many socio-economic/demographic/institutional characteristics of farm-and farmer-specific.

From in Table 20, the probability of adoption of the recommended SSTF crop production practices declines with increases in the farmer's age, household size, farm size and land tenure variables. The estimates of age, household size, farm size and land tenure variables were statistically insignificant and negatively related to the decision to adopt the recommended SSTF crop production practices. The likelihood of adoption increases with increases in years of crop production experience, years of schooling, amount of credit used, access to extension visit, and average annual income variables. This means that though the probability of adoption of the recommended SSTF crop production practices decreases with age, household size, farm size and land tenure variables, they were not statistically significant in influencing the farmers' decision to adopt in this study.

Table 20: Log likelihood estimate of adoption of recommended SSTF crop production practices decision model

| **Variable** | **Coefficient** | **Std error** | **T – ratio** | **Significant level** |
|---|---|---|---|---|
| Constant | -2.442** | 1.022 | -2.390 | 0.0169 |
| Age | -0.035 | 0.024 | -1.446 | 0.1481 |
| Household size | -0.027 | 0.027 | -1.020 | 0.3077 |
| Years of experience | 0.113*** | 0.021 | 5.492 | 0.0000 |
| Farm size | -0.001 | 0.033 | -0.032 | 0.9747 |
| Years of schooling | 0.618*** | 0.075 | 8.276 | 0.0000 |

| | | | | |
|---|---|---|---|---|
| Credit used | 0.237* | 0.126 | 1.891 | 0.0586 |
| Extension visit | 0.233** | 0.093 | 2.513 | 0.0127 |
| Annual Income | 0.163*** | 0.062 | 2.653 | 0.0002 |
| Market distance | 0.040 | 0.033 | 1.216 | 0.2241 |
| Land tenure | -0.246 | 0.348 | -0.707 | 0.4795 |

-2loglikelihood = -96.21, Cox & Snell $R^2$= 0.663, $X^2$ = 103.42;
***p<0.01; **p<0.05; *p<0.10.

The years of crop production experience, years of schooling and average annual income variables exhibited the expected signs and are statistically significant at 1% level of probability. The increased probabilities of the decision to adopt the recommended SSTF crop production practices with more years of schooling, crop production experience and access to extension visits were most probably due in large part to awareness of the benefits of adopting improved production techniques. Ideally, educated farmers are more innovative and likely to understand the benefits obtainable from meeting an extension agent and adopting the innovations brought to them. This agrees with Awotide *et al*. (2010) when they observed that years of experience in upland rice production, educational level and contact with extension agents significantly increased the decision to adopt improved rice varieties in Nigeria. The implication of this is that highly educated and experienced farmers with access to extension visit were better adopters in the study area.

Furthermore, the results of the regression analysis show positive coefficients and significant t-ratios on the relationship between amount of credit used by farmers and their decision to adopt recommended SSTF crop production practices, and between average annual income of the farmers and the adoption decision of recommended SSTF crop production practices. The amount of credit used and average annual incomes variables were, respectively, significant at 10% and 1% level of probability. The

implication is that the farmers' probability to adopt the recommended SSTF crop production practices increases with increase in amount of credit obtained by farmers and their average annual income. This finding is consistent with that of Asiabaka *et al*. (2001).

### 4. 4 Impact of Adoption of SSTF Recommended Crop Production Practices on the Farmers' Income

The adopters of the crop production practices introduced by the SSTF enjoyed a very high increase of 844.35% in their income (from ₦235,683-₦1,990,000), resulting in a difference of income between the post intervention and pre intervention periods of ₦1,754,317 which was significant at 1% (Table 21). The non- adopters had an increment of ₦284,974 in their income within the same period of time and was not statistically significant. The project thus has positive impact on the income of the farming households in the study area.

Table 21: Double difference estimate of the impact of adoption of SSTF improved crop production practices on farmers' mean annual income (₦'00)

| | **Pre Intervention** | **Post Intervention** | **Difference between income at different periods** |
|---|---|---|---|
| Adopters | 2356.83 | 19900 | 17543.17 |
| | (177.77) | (1779.04) | (1367.07)* |
| Non-adopters | 2448.98 | 5298.72 | 2849.74 |
| | (159.14) | (448.01) | (1426.06) |
| Difference between groups | -92.15 | 14601.28 | 14693.43 |
| | (6.29) | (1027.11) | (1631.52)* |

Note: * indicates significant at 1% level
Figures in parentheses are the standard errors

A T-test was run to determine the impact of adopting SSTF recommended crop production practices on farmers' income. The pool data of the on-farm income was

disaggregated into adopters and non-adopters for comparison. The result of the T-test (Table 22) indicated that there was significant difference between adopters and non-adopters in relation to income level at 1% level of probability.

The Coefficient of variation (CV) in the income was calculated to investigate the level of variation in income. The CV of adopters and non-adopters were 1.47 and 0.42, respectively. This indicates that there exists less variation in income among the non-adopters than adopters (Table 22). This may be due to small land area put into cultivation of these crops and the low output from production by these non-adopters, which may not be statistically significant.

Table 22: T-test result of adopters versus non-adopters in relation to income

| **Estimate** | **Adopters ($X_1$)** | **Non- Adopters ($X_2$)** |
|---|---|---|
| Observation | 137 | 163 |
| Maximum | 10,500,000 | 436,950 |
| Minimum | 18,110 | 20,600 |
| Average | 760,515 | 252.169 |
| Standard deviation | 1116796.83 | 106052.9 |
| Coefficient of variation | 1.47 | 0.42 |
| Differential | 508,346 | |
| Standard error | 103721.09 | |
| **t – value** | **4.90*** | |

* P<0.01

### 4. 5 Impact of Adoption of Recommended SSTF Crop Production Practices on Technical Efficiency of Farmers

The estimation of the Cobb–Douglas stochastic production function simultaneously with the technical inefficiency effects in Equation (17) (Coelli, 1996) generated the

results shown in Table 23. The value of $\gamma$ =0.899 is statistically significant at the 1% level, which implies that about 90% of the residual grains production by the sampled farmers is due to the inefficiency effect. The sigma squared ($\sigma^2 = \sigma_u^2 / \sigma_v^2$) was also significant at 1% level of probability, indicating a good fit and the correctness of the specified half normal distributional assumption made on the efficiency error term.

Automatically, the analysis generated result of the hypothesis that states that there is no any measurable inefficiency in grains production among the sampled farmers. The one-sided generalized likelihood ratio tests of $\gamma = 0$ generated a statistic of 39.67 distributed as $\chi^2$ with eight degrees of freedom, which is statistically significant at 1% level, indicating that the average production function is not a suitable specification of grains production and technical efficiency effects are not random errors. Thus, there is some measurable inefficiency in grains production among the sampled farmers.

All the coefficients of the inputs in the production function were positive and statistically significant at the 1% level, implying direct relationship between each of the inputs and grains output. The production elasticities for all the inputs have the expected positive signs. This result implies that 1% increase in seed in grains equivalent, labour and fertilizer by the grains farmers will increase yield by 0.11%, 0.06% and 0.04% respectively. Among the three production inputs, seed has the highest impact on yield. This is due to the fact that yield is directly depended on the number of plants per hectare, and population of plants is directly related to the quantity of seed used. The estimated return to scale is 0.596, land inclusive, which implies a decreasing return to scale exists in grains production in the study area. Therefore, an increase in all production inputs by 1% increases grains yield by less than 1%, *ceteris paribus.*

Table 23: Maximum likelihood estimates of the Cobb-Douglas stochastic frontier production function (dependent variable lny=lngrains equivalent (GE) of total output in kg)

| Variables | Parameters | Coefficient | T – values |
|---|---|---|---|
| **Stochastic frontier** | | | |
| Constant | $\beta_0$ | 7.240* | 43.738 |
| ln Farm size ($X_1$) | $\beta_1$ | 0.367* | 10.446 |
| ln Seed GE ($X_2$) | $\beta_2$ | 0.112* | 2.625 |
| ln labour ($X_3$) | $\beta_3$ | 0.072* | 2.591 |
| ln Fertilizer ($X_4$) | $\beta_4$ | 0.044* | 3.858 |
| **Inefficiency model** | | | |
| Constant | $\alpha_0$ | -1.527 | -0.174 |
| Age of farmer (years) | $\alpha_1$ | 0.129 | 0.321 |
| Household size | $\alpha_2$ | 0.026 | 0.297 |
| Years of experience | $\alpha_3$ | -0.060* | -3.301 |
| Years of schooling | $\alpha_4$ | 0.112** | 2.379 |
| Extension visit dummy | $\alpha_5$ | -0.340* | -6.783 |
| Annual Income (₦) | $\alpha_6$ | -0.563* | -3.542 |
| **Variance Parameters** | | | |
| Sigma squared | $\sigma^2$ | 0.150* | 3.657 |
| Gamma | $\gamma$ | 0.899* | 3.347 |
| Log likelihood function | | -188.446 | |
| Number of observations | N | 300 | |
| Mean Technical Efficiency | $\overline{TE}$ | 0.801 | |

*P<0.01, ** P<0.5; $\chi^2$ (P<0.01)

The average technical efficiency for the sampled grains farmers in the study area is 0.801 (Table 23). This implies that on the average, the farmers were able to obtain over 80% of potential output from a given mix of production inputs. Thus, in a short run, there is a room for increasing grains production by about 20%, by adopting the technology and techniques used by the best farmers.

This section also reported on determinants of technical inefficiency estimated in the Table 23. The inefficiency model was specified in equation (18). Generally, a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The results on Table 23 showed that years of farming experience, extension visit and average annual income had negative signs, and therefore reduce technical inefficiency (or increase technical efficiency) while age of farmers, household size and years of schooling had positive signs, implying that they increase technical inefficiency. The negative sign on the years of farming experience variable indicates that an increase in the number of years in grains production decreases technical inefficiency; this relationship is significant at the 1% level. This finding is consistent with a study by Ojo and Ajibefun (2000).

The years of schooling variable has a positive sign and statistically significant at 5% level of significance. This indicates that level of education attained reduce technical efficiency. This could probably be explained by the fact that high level of education attenuates the desire for farming and therefore the farmers probably devoted much of their time on salaried employment instead. This finding agreed with the result of Ojo (2003) and Usman (2009). Extension visit was observed to be negatively related with inefficiency as the negative sign on parameter have shown. This agreed with the a priori expectation that access to extension visit is positively correlated to adoption of improve technology and techniques of production which improve technical efficiency. This finding is consistent with the result of Usman (2009), which found that extension visit increases technical efficiency in sesame in Jigawa State.

Average annual income in Naira was found to be significant at 1% level of probability and negatively related to inefficiency. Higher income usually boosts farmers' purchasing power to enable them acquire modern and improved technologies for their farm production. This will lead to increase in their technical efficiency.

### 4.5.1 Frequency distribution of technical efficiency scores

The frequency distribution of the technical efficiency estimates obtained from the stochastic frontier model for each farmer is disaggregated into adopters and non-adopters and presented in Table 24. The minimum, maximum standard deviation of technical efficiencies estimates for the adopters were 0.59, 0.92 respectively, while those of non-adopters were 0.28, 0.83 respectively. The mean technical efficiency for the adopters and non-adopters were 0.87 and 0.65 respectively. This implies that the adopters were more technically efficient than the non-adopters. Only 13% of the potential yields were lost due to inefficiency in grains production by adopters while 35% of the potential yields were lost by non-adopters. In the short run, there is a scope for increasing grains production by 13% and 35% by adopters and non-adopters respectively by adopting technologies and techniques used by the best practice grains farms. Over50% of the farms of the adopters operate at more than 85% efficiency level while none of the non-adopters' farms have TE that exceeded85%.

Table 24: Frequency distribution of technical efficiency estimates for treatment and counterfactual farmers

| Efficiency Range | Treatment | | Counterfactual | |
|---|---|---|---|---|
| | **Frequency** | **%** | **Frequency** | **%** |
| 25 – 35 | - | - | 4 | 2.45 |
| 36 – 45 | - | | 9 | 5.52 |
| 46 – 55 | - | | 11 | 6.75 |
| 56 – 65 | 2 | 1.46 | 23 | 14.11 |
| 66 – 75 | 19 | 13.87 | 53 | 32.52 |
| 76 – 85 | 47 | 34.31 | 63 | 38.65 |
| ≥ 86 | 69 | 50.36 | - | - |
| **Total** | **137 100** | | **163100** | |
| Maximum TE | 0.92 | | 0.83 | |
| Minimum TE | 0.59 | | 0.28 | |
| Mean TE | 0.87 | | 0.65 | |

### 4.6 Determinants of Propensity to Escape from Poverty

The results of the analysis (Table 25) indicated that the overall predictive power of the model (92.2%) is high and the Hosmer-Lemeshow chi-squared is significant (P<0.01), implying the strength of the joint effect of the covariates on the probability of the determinants to escape from poverty among crop farmers in the study area. The explanatory variables except age of farmers, household size and land tenure were found to be significant at least, 10% level of probability.

The parameters of years of crop production experience and years of schooling revealed that probability to escape from poverty significantly increase (P<0.01) as farmers' years of crop production experience and schooling increases. This goes in line with the finding of Oyekale and Idjesa (2009). It is also anticipated that experienced and educated farmers may be able to appreciate the importance or impact of adopting improved technologies brought to them by SSTF on their income. Also, the likelihood to escape from poverty significantly increased (P<0.10) as the amount of credit used by

farmers and access to extension visit. Some studies (Oyekale and Idjesa, 2009; Okunade, 2006) have reported similar findings.

The coefficient of adoption was positive and significant (P<0.10), providing what was referred to as the Average Treatment Effect (ATE). This is the average difference between adopters and non-adopters for the probability to escape from poverty, which is thus the impact of the adoption of SSTF recommended crop production practices on farmers' income. Farm size variable related positively and significantly (P<0.05) to the chances to escape from poverty because the owner of the large farm would usually have a higher capital investment and this could lead to, *ceteris paribus*, more output produced at lower cost, as is common to economics of scale. In their study on "Impact of size of farm operation on resource use efficiency in small scale farming in south western Nigeria", Ajibefun and Abdulkadri (2004) observed that as the size of farmers' plot increases also their income increases.

Market distance was statistically significant (P<0.01) but negatively related to the propensity to escape from poverty, implying that the more closer a farmer is to the market the higher the probability to escape poverty. This is because it is expected that farmers that are closer to the market take their crop outputs to the market for sale and in the process get some information on new production technique or even purchase such technique for trial, but those that are far away from market sell their outputs at farm gate price or even produce only to satisfy subsistence needs.

Table 25: Probit regression results of the crop farmers' determinants of propensity to escape from poverty

| **Variable** | **Coefficient** | **T – ratio** | **P value** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Constant | -0.081 | -0.181 | 0.8561 |
| Age | -0.010 | -0.991 | 0.3215 |
| Household size | 0.008 | 0.795 | 0.4265 |
| Years of expce | 0.029* | 3.378 | 0.0002 |
| Farm size (ha) | 0.038** | 2.467 | 0.0136 |
| Years of schooling | 0.106* | 5.239 | 0.0000 |
| Amount of credit | 0.100*** | 1.752 | 0.0765 |
| Extension visit | 0.287*** | 1.676 | 0.0938 |
| Market distance | -0.012* | -2.673 | 0.0045 |
| Land tenure | -0.180 | -1.026 | 0.3051 |
| Adoption | 0.316*** | 1.820 | 0.0687 |

Restricted log likelihood = -203.0576, McFadden Pseudo R-squared= 0.84124
Hosmer-Lemeshow chi-squared = 34.09127 ( p=0.0000)
*P<0.1, **P<0.05, ***P<0.10

### 4.7 Constraints Militating against Crops Production in the Study Area

The widespread and increased production of crops in the study area within the period of survey was not without constraints. The major constraints observed from the study are presented in Table 26. High cost and scarcity of inputs, low profit obtained from crop production, problems of output transportation, difficulties in processing and storage, inconsistency in government policy, lack of market information, low quality of produce, and limitations of output market outlets were the most prominent problems militating against crop production in the study area. High cost and scarcity of inputs was ranked first (21.32%). Inputs such as fertilizer, chemicals, and improved seeds were very expensive and scarce in the study area during the survey. It is a generally believed that once the inputs prices are high and the outputs are sold at the time of harvest and at farm gate, this will lead to low profit (17.56%), which was ranked as the second major problem.

A problem of transporting crop outputs to major markets is also one of the major problems facing crop farmers in the study area, and ranked third (17.24%). The cost of transporting crop outputs from the various villages to the market is considered very high, and this is attributed mainly to the bad conditions of roads. Sometimes, a farmer pays a high price per bag of his threshed output before reaching rural market. Other problems include difficulties in processing and storage, ranked fourth with about 17%, inconsistency in government policy, ranked fifth with over 16%, followed by lack of market information ranked sixth with about 9%. Other problems as reported by the farmers were low quality of produce and limitations of output market outlets ranked seventh and eight respectively.

The implication of this finding is that the crop farmers in the study area are producing under high costs of inputs and poor output prices. This ultimately forced them to produce mainly to feed themselves and their families using small piece of land.

Table 26 Constraints militating against crops production in the study area

| Problem | Frequency | Percentage | Ranking |
|---|---|---|---|
| High cost and scarcity of inputs | 68 | 21.32 | 1st |
| Low profit | 56 | 17.56 | 2nd |
| Problem of transportation | 55 | 17.24 | 3rd |
| Difficulties in processing & storage | 53 | 16.61 | 4th |
| Inconsistent Government policy | 49 | 15.36 | 5th |
| Lack of market information | 27 | 8.46 | 6th |
| Low quality of produce | 8 | 2.51 | 7th |
| Limitations of output markets | 3 | 0.94 | 8th |
| **Total** | **319*** | **100** | |

* Multiple responses allowed

# CHAPTER 5

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.1 Summary

The study investigated the impact of improved crop production practices promoted by the Sudan Savannah Task Force, of Kano-Katsina-Maradi Pilot Learning Sites on farming house-holds in Katsina State, Nigeria. The objectives of the study were to: examine the socio-economic characteristics of the farming households, determine the rates and intensities of adoption of improved crop production practices of SSTF, identify and evaluate the factors that influence the adoption of improved crop production practices of SSTF, determine the impact of improved crop production practices of SSTF on the income of the farming households, evaluate the impact of improved crop production practices of SSTF on the technical efficiency of the farming households, identify and evaluate the determinants of escape from poverty among the crop farmers, and identify and describe the constraints militating against crops production.

The sample frame was derived from four Local Government Areas in Katsina State. A sample of households was selected by taking a sample of LGAs, a random sample of villages within each LGA, a random sample of households in each selected village. Finally, 30 villages selected within the clean, conventional and treatment sites. 10 households were randomly selected in each village giving a total of 300 households interviewed in the State. A combination of tools including the logit and probit models, double-difference indicator, Cobb-Douglass frontier production function, were used for the data analyses.

The results of the analyses showed that of the 231 crop farmers that have access to SSTF crop technology, only 137 (59.31%) were found to be adopters. The results of the mean differences in socio-economic characteristics between adopters and non- adopters

of SSTF recommended crop production practices in relation to number of years spent in farmers' cooperatives and amount of credit utilized in crop production were significant at 1% level of probability. Similarly, there was also a significant difference between adopters and non-adopters of SSTF recommended crop production practices in relation to years of membership of cooperative society at 10% level. The estimated mean adoption rates for the introduced new varieties of maize, sorghum, cowpea, millet and groundnut in the study area were: 67%, 46%, 54%, 46% and 52% respectively.

The average technical efficiency for the respondents was 0.801. This implies that on the average the farmers were able to obtain over 80% of potential output from a given mix of production inputs. Thus, in a short run, there is a room for increasing grains production by about 20%, by adopting the technology and techniques used by the best farmers. The minimum and maximum standard deviation of technical efficiencies estimates for the adopters were 0.59, 0.92 respectively, while those of non-adopters were 0.28, 0.83 respectively. The mean technical efficiency for the adopters and non-adopters were 0.87 and 0.65 respectively. This implies that the adopters were more technically efficient than the non-adopters. Only 13% of the potential yields were lost due to inefficiency in grains production by adopters while 35% of the potential yields were lost by non-adopters. In the short run, there is a scope for increasing grains production by 13% and 35% by adopters and non-adopters respectively by adopting technologies and techniques used by the best practice grains farms. Over50% of the farms of the adopters operate at more than 85% efficiency level while none of the non-adopters' farms have TE that exceed 85%.

The parameters of years of crop production experience and years of schooling revealed that probability to escape from poverty significantly increase (P<0.01) as farmers' years of crop production experience and schooling increases. Also, the likelihood to escape from poverty significantly increased (P<0.10) as the amount of credit used by farmers and access to extension visit. The coefficient of adoption dummy variable was positive and significant (P<0.10), providing what was referred to as the average treatment effect (ATE). Farm size variable related positively and significantly (P<0.05) to the chances to escape from poverty. Market distance variable was statistically significant (P<0.01) but negatively related to the propensity to escape from poverty, implying that the more closer a farmer is to the market the higher the probability to escape poverty.

High cost and scarcity of inputs, low profit obtained from crop production, problems of output transportation, difficulties in processing and storage, inconsistency in government policy, lack of market information, low quality of produce, and limitations of output market outlets were the most prominent problems militating against crop production in the study area.

## 5.2 Conclusion

The Sudan Savannah Task Force (SSTF) improved crop production practices have led to improved income and technical efficiencies of the crop farmers in the study area. The adopters of the improved crop production practices have enhanced income streams compared to non-adopters. There was an improvement in adoption rate of SSTF improved crop production practices.

## 5.3 Recommendations

The following are recommendations are suggested:

(i) Strong linkages should be established between the farmers and sources of introduced new seed varieties and fertilizers by the farming households through their cooperative societies to ensure access to inputs timely and at affordable prices;

(ii) Construction of good access roads that will ease the transportation of crop outputs to major markets should be a high priority of the State government;

(iii) Crop storage and processing should be embarked upon by the cooperatives to assist farmers store and process their farm produce;

(iv) Resources should be pulled together through membership of cooperative society to help farmers to produce the introduced crop varieties commercially to increase profits; and

(v) The Sub-Saharan Africa Challenge Programme (SSAP) should extend their funding of the project for more years to encourage sustained impact of the project on the farmers.

(vi) The impact assessment should be carried out at a later date to allow for enough time for the impact to be fully captured.

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## APPENDIX (QUESTIONNAIRE)

| | | | |
|---|---|---|---|
| **A. IDENTIFYING INFORMATION**<br>(a) Household N0 (**Filled in by supervisor)** | | | |
| (b)Name of supervisor | | | ( C) Date checked |
| | | | |
| 1. name of enumerator | | | |
| 2. date for interview | | | |
| 3. country | | | |
| District / L .G | | | |
| 5. province / region /state | | | |
| 6. sub-county/secateur/localidad/EPA/local government authority/ward | | | |
| 7. village | | | |
| 8. PLS | | | |
| 9. Task Force Sudan savannah | | | |
| 10. Household No (**filled in by supervisor)** | | | |
| 11. Name of head of household | | | |
| 12. Name of Respondent | | | |
| 13.Is respondent household head? 1=Yes 0=No | | | |
| 14. If not, relationship to household head? 1=Yes 0=No | | | |
| 99=other (specify) | | | |
| **NB:(as far as possible, interview should only be carried out with the two wife or adult children, relative,or others living at home)** | | | |
| 15. GPS coordinates of residence(waypoint) | | | (1) NORTHINGS:<br>(2) EASTINGS<br>(3) Elevation(m.a.s.l.) |
| **B. GENERAL HOUSEHOLD INFORMATION** | | | |
| **NB:The "household" refers to all members of a common decision making** | | | |
| **unit (usually within one residence)that are sharing incomes and other resources.** | | | |
| **Varriable** | **Response** | **Codes** | |
| **Demographic data** | | | |
| **1.Gender of Household head** | | 1=male | |
| | | 0=female | |
| **2. age of Household head in years** | | use your experience. | |
| **3. marriage status** | | | |
| | | 1=single | |
| | | 2=Monogamously married | |
| | | 3=polygamous married | |
| | | 4=widowed | |
| | | 5=separated / Divorced | |
| | | 6=other(specify) | |
| 4.If married age of spouse | | | |
| 5. If married to more than one spouse, age of spouse 2 | | | |

| | | |
|---|---|---|
| 6.Education level of household head | | 1=no formal education, 2=Adult education 3=some |
| | | Primaryeducation 4=completed primary education, |
| | | 5=some vocation training,6=completed vocational training, |
| | | 7=some secondary education, 8=completed secondary education, |
| | | 9=college education 10=university education. |

| | | |
|---|---|---|
| 7. Education level of spouse 1 | | |
| 8. education level of spouse 2 | | |
| 9. Highest level of education attained | | |
| by any family member | | |
| 10. number of males aged 16 to 58 years | | |
| 11. Name of females aged 16 to 58 years | | |
| 12. Name of members aged below 16 years | | |
| 13. Number of members aged 59 and above | | |
| 14. How many members of this family | | |
| are living away who regularly send remittance? | | |
| 15. Household size | | |
| 16. How long has the household head been farming as an independent household? | Number of years. When did he start | |
| **House characteristics/identifiers** | | |
| 17. Roofing material of household's most important residence | 1=straw/thatch, 2=mud, 3=wood/planks, 4=Iron sheets 5=asbestos, 6=bricks/tiles, 7=tin, 8=cement9=other roofing10=other walls 11=other floors | |
| 18. walls material of household most | | |
| important residence | | |
| 19. floor material of household mostimportant residence | | |
| 20. Number of rooms (minus kitchen and bathrooms) | | |
| 21. Type of household | 1=male headed (monogamous), 2=male headed (polygamous), 8=male headed(divorce)9=male headed(widowed), 99=other(specify) | |

| **C. LAND OWNERSHIP** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **NB:1 ha=2.47acres, 1 acre=0.405 hectares, 1ha=10000m, 1m=0.0001** | | | | | | | |
| **NB:please indicate here whether you use acres(=1), (=2) or (m(=3)** | | | | | | | |
| How muh land this household own now? | | | | | | | |
| **Row** | | (a) Homestead land | (b) upland away from home | (c)Wetland (if Fadama applicable) | (d) Other | (e) Total | (f) unit of measure 1 |
| 1 | Owned | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | sharecropped in/out | | | | | | |
| 3 | borrowed | | | | | | |
| 4 | RENTED OUT (FOR MONEY) | | | | | | |
| 5 | sharecropped out | | | | | | |
| 6 | Lent out (for free) | | | | | | |
| 7 | under crop cultivation(2009/10) | | | | | | |
| 8 | under woodlot (2009/10) | | | | | | |
| 9 | Total land under other uses (fallow,pasture,etc)(2009/10) | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| | | | | | | | |

| E. USE OF AGRICULTURAL TECHNOLOGIES | | | | | | |
|---|---|---|---|---|---|---|
| E (1) use of crop management, soil conservation and other land management options | | | | | | |
| NB: technology refers to any practice including traditional and agricultural practices | | | | | | |
| ROW | Technology/Management practice | (a) Do you know this technology? 1=yes, 0=no | (b) Most important source of information for technology? | ( C) Did you proactively askfor information 1=yes 0=n0 | (d)Have you ever used thistechnology in your main fields 1=yes, 0=N0 | (e) whend you first u this techno |
| **1. Soil and water Management** | | | | | | |
| 1.1 | Mulching | | | | | |
| 1.2 | Trenches/terraces | | | | | |
| 1.3 | water harvesting | | | | | |
| 1.4 | Irrigation(bucket,treadle pump,drip) | | | | | |
| 1.5 | Conservation farming | | | | | |
| 1.6 | | | | | | |
| **2. Soil fertility Management** | | | | | | |
| 2.1 | organic manure | | | | | |
| 2.2 | cover crops | | | | | |
| 3. Crop management practices | | | | | | |
| 3.1 | Row planting | | | | | |
| 3.2 | Planting Spacing | | | | | |
| 3.3 | Organic pesticide | | | | | |
| 3.4 | Inorganic pesticide | | | | | |
| 3.5 | | | | | | |
| 4. The three most important crops with improved varieties | | | | | | |
| 4.1 | | | | | | |

| | | | |
|---|---|---|---|
| 4.2 | | | |
| 4.3 | | | |
| 5. Others TF specific technologies (only ask if task force leaders filled in specific technologies here) | | | |
| 5.1 | | | |
| 5.2 | | | |
| | | | |

*1Codes for source of information on technologies: 1=Government Extension workers, 2=farmer Group members, 3=NGO, 4=Others farmers, 5=Radio, 6=Demonstration/research sites, 7=IP/LAR4D, 99=others (specify)*

**E (2) Use of post Harvest Technologies**

| Row | Technology | (a ) Do you know it? 1=Yes ,0=No | (b) Have you ever used it: 1=Yes ,0=No | (c ) Most important sources of information of technology? | (d) When did you first use it? (Year) | (e)Did you ask for information on it? 1=Yes ,0=No | (f) Did you use this technology during the 2009/10 season? 1=Yes ,0=No | ( w d th te |
|---|---|---|---|---|---|---|---|---|
| 1 | Drying | | | | | | | |
| 2 | Threshing/shelling equipment | | | | | | | |
| 3 | Improved storage facilities | | | | | | | |
| 4 | Pest control | | | | | | | |
| 5 | Grading | | | | | | | |
| 6 | | | | | | | | |
| 6 | | | | | | | | |

*1Codes for source of information on technologies: 1=Government Extension workers, 2=farmer Group members, 3=NGO, 4=Others farmers, 5=Radio, 6=Demonstration/research sites, 7=IP/LAR4D, 99=others (specify)*

**E (3) General access to inputs**

NB: Average cost € is to be given in one currency, please indicate here which currency used

1 How would you rate your access to the following inputs?

| Row | Type of inputs | ( a) Do you use the following inputs? | (b ) Common sources[1] | ( C) Distance from house to regular source (km) | (d) Time taken in hours to get to regular source | (e ) Perception of cost[2] |
|---|---|---|---|---|---|---|
| 1 | Fertilizer (NPK, Urea, DAP, SSP, others) | | | | | |
| 2 | Herbicides | | | | | |
| 3 | Fungicides | | | | | |
| 4 | Pesticides | | | | | |
| 5 | Animal Manure | | | | | |
| 6 | Certified Seed | | | | | |
| 7 | Seed dressing chemical | | | | | |
| 8 | Post harvest insect control | | | | | |
| 9 | Livestock supplementary feed | | | | | |
| 10 | Live stock drugs | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11 | Animal/mineral licks | | | | | | |

[1] ***Common source of inputs:*** *1=purchased from market; 2=purchased from stockists; 3=purchased other farmers; 4= received from government; 5=received from NGOs 99=Other (specify)*

[2] ***perception of cost:*** *1=Very affordable, 2=Affordable, 3=Not affordable*

[3] ***Other constraints to access:*** *1=Too far from household, 2=Unsuitable packaging(large), 3=No know of how to use,4=No transport,5=Not enough money 99=other (specify)*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | **Transplantin** | |
| Row | Parcel ID# | Plot ID# | 2 Cropping system | 3 Main crops grown on plot (in writing)* | 4 Used improved variety Yes=1 No=2 | 5 Source of seed/planting material | 6 Use recommended practices: row planting/ spacing? 1=Yes 2=No | 8 Quantity | Ur |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |

[1] **Cropping system:** 1=Pure stand (mono cropping); 2=Intercropping (two crops); 3= Mixed croppin (more than two crops); *99=Other (specify)*

[2]**Source of seed/planting material:** 1=Bought; 2=saved from own harvest; 3=Given by NGO/FBO 4=Given by Government; 5=Given by farmer organisation/CBO; 6=Given by trader; 7=Given b friend/relative; *99=Other (specify)*

[3]**State of produce:** 1=Fresh cobs with leaves 2=Dry cobs with leaves 3=Dry cobs without leave 4=Dry grain 5=Fresh pods 6= Dry pods *99=other (specify)*

*** Crop codes** should be written down in words, and will be post-coded during the data entry

| | | | **Land preparation** | | | | **Weeding** | | |
|---|---|---|---|---|---|---|---|---|---|
| Row | Parcel ID# | Plot ID# | 1. Land preparation method | 2. Total family labour for land | 3. Total hired labour for land | 4. Total cost of land preparation | 5. Number of weeding | 6. Total family labour for | 7. T labou weed |

| | | | | preparation (days) | preparation (days) | including hired labour (Currency) | | weeding (days) | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |

[1] **Land preparation method:** 1=hand hoe; 2=oxen; 3=tractor/mechanized; 4=chemical; 5=Tractor and

| Row Parcel ID# | | Plot ID# | 1 Used chemical fertilizer? 1=Yes 0=No If No→6 | 2 Type of fertilizer used | 3 Amount used (Kg) | 4 Did you buy it? 1=Yes 0=No | 5 Total value (Currency) | 6 Used organic fertilizer? 1=Yes 0=No If No→ | 7 Did you buy it? 1=Yes 0=No | 8 Type of organic fertilizer [3] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |

[1] **Soil type 1=**Sandy 2=Clay 3=Sandy loam 4=Clay loam

[2] **Soil fertility status** 1=very poor; 2=poor; 3=not poor not rich; 4=rich; 5= very rich

[3] **Position on slope codes:** 1=Summit; 2=Backslope; 3=Toe (valley); 4=Flat(Not on slope)

[4] **Tenure:** 1=Customary;2=Leasehold/rent; 3=Freehold, *99=other (specify)*

[5] **Land investments:** 1=Bench terraces, 2=Drainage trenches, 3-Stone wall/terraces, 4=Soil bunds, 5=
fence, 9=Wire or other types of fence, 10=No land investment, *99=other (specify)*

| Row | Parcel ID# | Plot ID# | 2 Cropping system | 3 Main crops grown on plot (in writing)* | 4 Used improved variety Yes=1 No=0 | 5 Source of seed / planting material | 6 Use recommended practices: row planting/ spacing? 1=Yes 0=No | 8 Quantity | Unit | 9 v ( |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |

[1] **Cropping system:** 1=Pure stand (mono cropping); 2=Intercropping (two crops); 3= Mixed cropping

[2] **Source of seed/planting material:** 1=Bought; 2=saved from own harvest; 3=Given by NGO/FBO; 4 6=Given by trader; 7=Given by friend/relative; *99=Other (specify)*

[3] **State of produce:** 1=Fresh cobs with leaves 2=Dry cobs with leaves 3=Dry cobs without leaves 4 *(specify)*

*** Crop codes** should be written down in words, and will be post-coded during the data entry

**E (2) Use of Post Harvest Technologies**

| Row | Technology | (**a**) Do you know it? Yes=1 No=0 | (**b**) Have you ever used it? Yes=1 No=0 | © Most important source of information of technology? | (**d**)When did you first use it (year) | (**e**) Did you ask for information on it? 1=Yes, 0=No | (**f**) Did you use this technology during the 2009/2010 season? 1=Yes, 0=No | (**g** c y ta |
|---|---|---|---|---|---|---|---|---|
| 1 | Drying | | | | | | | |
| 2 | Threshing/Shelling equipment | | | | | | | |
| 3 | Improved storage facilities | | | | | | | |
| 4 | Pest control | | | | | | | |
| 5 | Grading | | | | | | | |
| 6 | | | | | | | | |
| 6 | | | | | | | | |
| 6 | | | | | | | | |

***1 Codes for source of information on technologies:*** *1=Government extension workers, 3=Far members, 4=NGO, 5=Other farmers, 6=Radio, 7=Demonstration/research sites, 99=other (specify)*

| Row | Type of inputs | (a) Do you use the following inputs? 1=Yes, 0=No (→f) | (b)Common source [1] | (c) Distance from house to regular source (km) | (d) Time taken in hours to get to regular source | (e) Perception of cost [2] | (f) Ot constrain to access |
|---|---|---|---|---|---|---|---|
| 1 | Fertilizer (NPK, Urea, DAP, SSP, Others) | | | | | | |
| 2 | Herbicides | | | | | | |
| 3 | Fungicides | | | | | | |
| 4 | Pesticides | | | | | | |
| 5 | Animal manure | | | | | | |
| 6 | Certified seed | | | | | | |
| 7 | Seed dressing chemical | | | | | | |
| 8 | Post harvest insect control | | | | | | |
| 9 | Livestock supplementary feed | | | | | | |
| 10 | Livestock drugs | | | | | | |
| 11 | Animal/mineral licks | | | | | | |

[1] ***Common source of inputs:*** *1=purchased from market; 2=purchased from stockists; 3=purchased other farmers; 4= received from government; 5=received from NGOs 99=Other (specify)*

[2] ***perception of cost:*** *1=Very affordable, 2=Affordable, 3=Not affordable*

[3] ***Other constraints to access:*** *1=Too far from household, 2=Unsuitable packaging(large), knowledge of how to use,4=No transport,5=Not enough money 99=other (specify)*

**H. MARKETING OF AGRICULTURAL PRODUCE**

NB1:Ask question (a) for all crops before going on to questions b-p

NB2: If one product is sold in more than one form, enter each form on a separate row

NB3: price (e &m) is to be given in one currency, please indicate here which currency you used

NB4: Please convert units used (for example bag, ox cart pile ,bunchketetc) to kg, and insert this in qu

H (1) Marketing Strategies and linkage with agricultural traders

| | | Market 1(main market) | | | | | | | Market 2( in case of | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Row | Crop | (a) Did you sell? 1=yes 0=N0 | (b) If yes, quantity sold (kg) | (c ) Type of market 1 | (d)How far is market 1? | (e) price per unit in market | (f) If what form did you sell? 2 | (g)How did you sell? 3 | (h)Did you sell? 1=yes 0=N0 | (i)Ifyes, quantity sold (kg) | |
| 1. priority cereal crops | | | | | | | | | | | |
| 1.1 | | | | | | | | | | | |
| 1.2 | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.3 | | | | | | | | | | | |
| 2. priority legume crops | | | | | | | | | | | |
| 2.1 | | | | | | | | | | | |
| 2.2 | | | | | | | | | | | |
| 2.3 | | | | | | | | | | | |
| 3.. Priority fruits and vegetables | | | | | | | | | | | |
| 3.1 | | | | | | | | | | | |
| 3.2 | | | | | | | | | | | |
| 3.3 | | | | | | | | | | | |
| 4. priority root & tubers | | | | | | | | | | | |
| 4.1 | | | | | | | | | | | |
| 4.2 | | | | | | | | | | | |
| 4.3 | | | | | | | | | | | |

| **H (2) Sales of Livestock products (ask questions (a) for all products before going on to questions b-g)** | | | | | |
|---|---|---|---|---|---|
| ***NB1: not applicable to livestock traders*** | | | | | |
| ***NB1: amount (e ) is to be given in one currency,please indicate here which currency you used*** | | | | | |
| **H1 Sale of Livestock** | | | | | |
| Row | Breed | (a) Have you sold in the last 12 months? 1=Yes 2=No | (b) If yes how many have you sold? | (c) Most important type of market sold | (d) Distance to mark (km) |
| 1 | Cross breed cattle | | | | |
| 2 | Local cattle | | | | |
| 3 | Pure breed cattle | | | | |
| 4 | Improved goats | | | | |
| 5 | Local goats | | | | |
| 6 | Improved sheep | | | | |
| 7 | Local sheep | | | | |
| 8 | Improved pigs | | | | |
| 9 | Local pigs | | | | |
| 10 | improved chicken (broilers of layers) | | | | |
| 11 | Local chicken | | | | |
| 12 | | | | | |
| 12 | | | | | |
| 1 ***Type of market:****1=on-farm to consumers 2=on-farm to middlemen 3=on the road side 4=local/village market 5=district town 6=distant market 99=Other (specify)* | | | | | |
| 2 ***How*** *1=individually 2=collectively* | | | | | |
| **Sale of Livestock products** | | | | | |

***NB1:prices (e & f) is to be given in one currency, please indicate here which currency you used***

***NB2: Please convert units used (for example bag, ox cart,pile,etc) to one of the codes mentioned under unit codes (kg,litres or numbers)***

| H2 Sales of livestock products | | | | | |
|---|---|---|---|---|---|
| | | | | (c ) In the months when you produce [….], | (d) of the quantity how much does the household usually sell in a month? Unit^1 |
| | | | | | |
| | | | | | |
| Row | Product | (a) Did you produce during the past 12 months? 1=Yes 0=No | (b) How many months a | Amount/Unit^1 | Amount/Unit^1 |
| 1 | Eggs | | | | |
| 2 | Milk | | | | |
| 3 | Butter | | | | |
| 4 | Meat | | | | |
| 5 | Hides | | | | |
| 6 | Manure | | | | |
| 7 | | | | | |
| 7 | | | | | |

***1 Unit codes*** *1=Litres 2=Kilograms 4=Number*

***2 Type of market:*** *1=0n-farm to consumers 2=on-farm to middlemen, 3=on the road side, 4=local village market, 5=district town, 6=distant market, 99=Others(specify)*

**H (3) Collecting marketing and other group activities**

1. Did you sell collectively your agricultural goods and services in the past 12 months? Yes=1 No=0

2. Did you buy collectively your agricultural goods and services in the past 12 months? Yes=1 No=0

***NB: Only for farmers who responded that they have sold or bought collectively in H (4) above***

If you produce, process or sell your product in cooperation with other farmers or have a binding contract with traders, please report the frequency of meetings,your empowerment to make decisions or the group activities and terms and conditions of the contract. Mention at most three groups that members of this household participate in for collective marketing.

| Row | Attribute | (a) Group 1 | (b) Group 2 | © Group 3 |
|---|---|---|---|---|
| 1 | Name of group | | | |
| 2 | Most important activity of group^1 | | | |
| 3 | Year this household first participated | | | |
| 4 | # of female family members belonging to this group^1 | | | |
| 5 | # of male family members | | | |

| | | | | |
|---|---|---|---|---|
| | belonging of this group | | | |
| 6 | Frequency of meetings per yer | | | |
| 7 | Who initiated this group?^2 | | | |
| 8 | Who sets the prices?^3 | | | |
| 9 | Do you have a contract between the group and traders? Yes=1 No=0 | | | |
| 10 | If yes, what type of contracts?^4 | | | |
| 11 | Preception on empowerment to set terms of the contract with traders^5 | | | |
| 12 | Perception on empowerment to set terms of the contract with traders^5 | | | |
| 13 | Perception on empowerment to make decisions of group activities^5 | | | |
| 14 | Three most important benefits of group marketing | | | |
| 14.1 | | | | |
| 14.2 | | | | |
| 14.3 | | | | |
| 15 | Three most important constraints of group marketing | | | |
| 15.1 | | | | |
| 15.2 | | | | |
| 15.3 | | | | |

1 ***Main activity:*** *1=Production 2=Processing 3=Marketing 4=Production& processing 5=Production and marketing 6=Processing and marketing 7=Production,processing and marketing 99=Others (specify)*

2 ***Who initiated formation of this group:****1=farmer group 2=trader group 3=individual trader 5=NGO 6=FBO 8=Government official 9=Village/local government leaders 10=Project 11=Farmer (respondent) 12=other farmers/friends/relatives 13=IP/IAR4D, 99=Other(specify)*

3 ***Who sets prices:*** *1=farmers as a group 2= Traders 3=Farmers in consultation with traders 99=Other (specify)*

4 ***Contract:****1=signed contract 2=informal/word of mouth 3=Other (specify)*

5 ***Perception of empowerment:*** *1=very empowered 2=slightly empowered 3=not empowered-all decisions are made by other people*

**H (5): Constraints to marketing**

What are the priority constraints to crop and livestock marketing (**also see constraints on next page)?**

| Row | (a)constraint to crop marketing | (b) Rank (1 being the top constraints) | (c ) Constraint to livestock marketing | (d) Rank (1 being the top most constraint) |
|---|---|---|---|---|
| 1 | Low quality of produce | | Low quality of produce | |
| 2 | Low market price at the time of selling | | Low market price at the time of selling | |
| 3 | Unavailability or limitations | | Unavailability or limitation of | |

| | | | | |
|---|---|---|---|---|
| | of markets | | markets | |
| 4 | Lack of market information | | Lack of market information | |
| 5 | Difficulties in processing | | Difficulties in processing | |
| 6 | Difficulties in storage | | Difficulties in storage | |
| 7 | Transport to the market | | Transport to the market | |
| 8 | Farmers are not organized to market collectively | | Farmers are not organized to market collectively | |
| 9 | Difficulties in setting prices | | Difficulties in setting prices | |
| 10 | Government policy | | Government policy | |
| 11 | | | | |
| 11 | | | | |

**H (6) Access to market information**

1 From whom or from which organization do you primarily obtain market information?

| Row | Type of information | (a) Do you receive 1=Yes 0=No | (b) source of information^1 | ( c) How does this information affect decisions? |
|---|---|---|---|---|
| 1 | Commodity prices in different markets | | | |
| 2 | What commodities are on demand | | | |
| 3 | When commodities are demanded | | | |
| 4 | Supply in different markets | | | |
| 5 | Availability of services e.g transport | | | |

1 ***Source of information:*** *1=Other farmers 2=Family and friends 3=Radio/TV 4=Farmer organization/cooperative 5=Other non-farmer associations 6=Market place posters/posted bulletin 7=Agricultural traders 8=SMS messages 9 Internet 10=Newspaper 11=Extension officer 99=Other (specify)*

2 ***How you use information:*** *How do you use this price and market information? 1=Affect purchasing decisions 2=Affect sales decisions 3=Affect stocking decisions 4=Affect contracting decisions 5=Affec investment decisions 99=Others(specify)*

**H (7) Membership in farmer associations**

1. Are you or any member of your household a member of other groups that are not dealing with marketing Yes=1 No=2 If no,go to section I

2. IF yes, which groups and what are their most important activities?

| Row | (a) Name of group, organization or an association | (b) Membership of group^1 | (c ) Total membership | (d) Most important activity of the group^2 | (e ) For how many years have you been a member |
|---|---|---|---|---|---|
| 1 | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |

1 ***Membership of group:****1=Women only group 2=Men only group 3=Mixed group 4=cooperative society 99=Other (speify)*

2***Main activity:*** *1=Production 2=processing 3=social 4=savings and credit 5=kinship 99 Other (specify)*

3***Registerd member:*** *1=Husband 2=Wife 3=Son 4=Daughter 5=Relative 6=Several 99= Other (specify)*

4 ***Assessment of benefits:*** *1=Not beneficial 2=fairly beneficial 3=Beneficial 4=Very beneficial*

5***Who assisted initiation of group?*** *1=Another farmer group 2=trader group 3=individual trader 4=trader group 5=NGO 6=CBO 7=FBO 8=Government official 9=Village/local government leaders 10=Project 11= farmer (respondent) 12=other farmer friends 13=IP/IAR4D 99=Other (specify)*

**I. ACCESS TO CREDITS SERVICES, INFORMATION, EXTENSION, AND TRAINING**

0: **(b) is to be given in one currency, please indicate here which currency you used**

| **1 (1) Access to credit** | | | | |
|---|---|---|---|---|
| Do you have access to any of the following sources of credit? | | | | |
| Row | Sourceof borrowed money | (a) Have you ever borrowed money? 1=Yes 0=No | (b) Amount borrowed in the last 12 months | (c) Purpose of borrowing |
| 1 | Relative and friends | | | |
| 2 | Informal savings and credit group | | | |
| 3 | Money lender | | | |
| 4 | Government credit schemes | | | |
| 5 | NGO/Church | | | |
| 6 | Bank or micro-finance institution | | | |
| 7 | Input and Output dealers | | | |

***Purpose for borrowing:****1=Purchase of food 2=Purchase of household assets 3=Payment 0f fees 4=Cover medical costs 5=Agricultural production 6=Cover educational costs 99=Others (specify)*

**1 (2) Access to and use of agricultural extension services**

1. Did anyone in your household visit or receive an agricultural extension agent or an agricultural extension center during the last 12 months to seek advice or assistance on growing crops or livestock management? Yes=1 No=2

2. If yes, how many times during the last 12 months did member of your household do this?

3. what kinds of assistance or information were requested? Tick where appropriate

| Row | (a) Crop production | (b)Did you request 1=Yes 0=No | © livestock production | (d) Did yo request 1=Ye 2=No |
|---|---|---|---|---|
| 1 | Use of fertilizer | | Disease management | |
| 2 | Use of improved varieties | | Feed/ nutrition | |
| 3 | Pest and disease management | | Insemination services | |
| 4 | Soil management | | Marketing advice | |

| | | | | |
|---|---|---|---|---|
| 5 | Weather information | | Credit | |
| 6 | Marketing advice | | General livestock management | |
| 7 | Credit | | | |
| 8 | General crop production advice | | | |

4. During the past 12 months, did any agricultural extension agent visit your household? Yes=1 No=0

5. How many times did any agricultural agent visit your household during last 12 months?

**I (3) Participation in research activities**

1. Have you or any member of this household participate in any agricultural research or extension demonstration plot or research plots? (Yes=1 NO=0)

2. If yes, complete the following table

| Row | Type of technology being demonstrated (If several,mention at most 3) | | | |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

3. Distance to research site from homestead (km)

4. Who decided on the technologies to be researched/demonstrated[1]

5. What was your role in the research/ demostration[2]

6. Perception on usefulness of the research/ demonstration

7. Have you adopted any of the technologies demonstrated? Yes=1 No=0

8. If no, why not? (use codes below)

1***Type of technology:*** *1=Crop variety 2=Soil erosion control structures 3=Agroforestry 4=Soil fertilit improvement 5=Crop protection 6=Post-harvest handling 7=Tillage method 8=plant placing and other management practices 99=Other (specify)*

2***Who decided:*** *1:eseacher/extension officers 2:Researchers/extension in consultation with farmers 3:Researchers,extension and farmers agreed 4=Farmers 99= Other (specify)*

3***Role in the research/demonstration*** *1=Just watch and learn 2=provided labour 3=Provided land 4=Collected data 5=Made decision on the research 99=Other (specify)*

4***Usefulness:*** *1=Not useful 2=Somehow useful 3=Useful 4=Very useful*

5***Reason for not adopting*** *1=lack of planting material 2=Research not useful 3=Lack of land 4=Lack of inputs 5=Lack of labour 99=Other (specify)*

**I (4) Interaction with other farmers and farmer groups**

In the last past 12 months, how often has a member of your household participated in the following?

| Row | Aspects | (a) how would you rate the occurrence?1 | (b) How often di it occur in the la 12 months? |
|---|---|---|---|
| 1 | Participation in community development activity | | |
| 2 | Made financial contribution for community activities or collective problems | | |
| 3 | Been involve in settling conflicts or disputes among people | | |
| 4 | Visited other farmers within your community to learn about agriculture | | |
| 5 | Visited other farmers outside your community to learn about agriculture | | |
| 6 | Visit a research station to learn about | | |

| | | | |
|---|---|---|---|
| | agriculture | | |
| 7 | Visit an extension office to learn about agriculture | | |

1***Occurrence*** *0=Never happens 1=poor 2=Average 3=Very good 4=Excellent*

**I (5) Most recent interactions**

in the last 12 months, who are the person you have interested with to exchange agricultural information trade goods or other information?

| Row | Name of person | Sex | Distance from your home to them(km) | Type of interaction | Frequency of interaction^ |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |

1***Sex:****1=Male 0=Female*

2***Type of interaction:****1=information exchange 2=Commercial business transactions 3=materials exchange 4=money exchange 99=other (specify)*

3***Frequency of interaction:*** *1=Daily 2=Weekly 3=monthly 4=every 6 months 5=annualy or less*

4 ***Perception of strenght of interaction:****1=very week 2=weak 3=moderate 4=strong 5=very strong*

5 ***Role of the person:*** *1=Fellow farmer 2=Community/group leader 3=Extension agent 4=Researcher 5=Trader 6=NGO staff 99=Other (specify)*

I (6) Evaluation of Existing interactions and approaches:

1. In your view, how would you rate the methods/approaches of research / advisory / training services that you have received from various service providers in the past two years? (not more than six)

| Row | (a) Which organization have you been receiving agricultural services (information, technologies, training) from? | (b) Methods / approaches used 1 | ( c) Usefulness of advice / Research2 | ( d) Timeliness of service provision3 | ( e) Collaboration with extension & research | (f) Collaboration with farmers4 | (g ncy on |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4<br>5 | | | | | | | |
| 6 | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | 1Perception on methods: 1=Very Poor, 2=Poor, 3=Good, 4=Very Good | | | | |
| | 2Perception of usefulness of advice: 1=Not useful, 2=Somehow useful, 3=Useful, 4=Very useful | | | | |
| | 3Timeliness of service provision: 1=Untimely, 2=Always provided late, 3=Not always timely, 4=Timely | | | | |
| | 4Collaboration: 1=Very Poor, 2=Poor, 3=Good, 4=Very Good | | | | |
| | 5Frequency of interaction: 1=very infrequent, 2=occasional, 3=Regular, 4=Very regular | | | | |
| I (7) Social Capital | | | | | |
| NB: The recall time period can be clarified by situating it before/after a major event | | | | | |
| NB: These groups organizations, Networks or Associations could be formally organized groups or just groups of people who get together regularly to do an activity or talk about things | | | | | |
| Row | Groups, Organizations, Networks or Associations | 1. Please look carefully at the following list of voluntary organizations and activities and indicate if you are a member. Type Yes=1, or No=2 | 2. Of how many groups of this type are you a member of? | 3. Compare to two years ago, did this increase(=1), Remain the same(=2) or decrease(=3)? (if no, go to next group/question) | 4. If there was a change, what caused it? (-no fixed codes, -add answer in writing - clear handwriting please) |
| 1 | Village committee | | | | |
| 2 | Village NGO or civic group | | | | |
| 3 | Political group or movement | | | | |
| 4 | Water and Waste management group | | | | |
| 5 | Finance, Credit or Savings group | | | | |
| 6 | Helth group | | | | |
| 7 | Education group | | | | |
| 8 | Burial society or Festival society | | | | |
| 9 | Religious or | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Spiritual group | | | | |
| 10 | Cultural group or Association | | | | |
| 11 | Sports group | | | | |
| 12 | | | | | |
| 1Change: 1=Increase , 2=Remain the same, 3=Decrease | | | | | |
| 5. If you suddenly needed a small amount of money (equal to one week's wages) or faced a long term emergency such as a harvest failure, how many people beyond your immediate HH could you turn to who would be willing to assist you? (please estimate a number, even if there are many) | | | | | |
| 6. Compared to two years ago, did this increase, remain the same or decrease? 1=Increase, 2=Remain the same, 3=Decrease | | | | | |
| 7. If there was a change, what caused it? | | | | | |
| 8. Generally speaking, would you say that most people can be trusted? 0=No, 1=Yes | | | | | |
| 9. Compared to two years ago, did this increase, remain the same or decrease? 1=Increase, 2=Remain the same, 3=Decrease | | | | | |
| 10. If there was a change, what caused it? | | | | | |
| 11. How would you describe trust in the following groups: | | | | | |

| Row | Groups of people | 11. In general, how would you describe your trust in the following groups of people? (ranging from very poor to very good)? | 12. Compared to two years ago, did this increse(=1), Remain the same(=2) or decrease(=3)? (if no, go to next group/question) | 13. If there was a change, what caused it? (-no fixed codes, -add answer in writing - clear handwriting please) |
|---|---|---|---|---|
| 1 | People from your own village | | | |
| 2 | People outside your village | | | |
| 3 | Complete strangers | | | |
| 4 | Local government Officials | | | |
| 5 | Central Federal Government oficials | | | |
| 6 | Agricultural Traders | | | |
| 7 | Research | | | |

| | | | | |
|---|---|---|---|---|
| | Institues | | | |
| 8 | NGOs | | | |

1Extent: 1= Very Poor, 2=Poor, 3=Not poor nor good, 4=Good, 5=Very good

2Change: 1=Increase, 2=Remain the same, 3=Decrease

14. If a community project does not directly benefit you, but has benefits for many others in the village/community, would you be willing to contribute time and money to the project? 0=No, 1=Yes

14.1: Time 0=No, 1=Yes

14.2: Money 0=No, 1=Yes

15. Compared to two years ago did this increase, remain the same or decrease? 1=Increase, 2=Remain the same, 3=Decrease

**J. WELFARE INDICATORS**

J(1): Household Income

NB: Amount (d) is to be given in These groups organizations, Networks or Associations could be formally organized groups or just groups of people who get together regularly to do an activity or talk about things

1. What are your priority sources of income and what is the income estimate from these sources for the last 12 months? Which household members are engaged in these business or wage labour activities? (Ask for each source one at a time and if the household does not get income from that source, move to the next)

| Row | Income Source | (a) Do you get income from this source 1=Yes, 0=No | (b) From whom within the household? | ( c) How regular do you get income from this source1 | (d) What is the estimated amount that you have got from this source in the last 12 months (currency) | ( e) What importance would you give this source of income in terms of contributing to total household income2 |
|---|---|---|---|---|---|---|
| 1.1 | Sale of crops | | Head | | | |
| 1.2 | | | Spouse | | | |
| 1.3 | | | Other | | | |
| 2.1 | Sale of livestock | | Head | | | |
| 2.2 | | | Spouse | | | |
| 2.3 | | | Other | | | |
| 3.1 | Sale of other products e.g firewood, trees | | Head | | | |
| 3.2 | | | Spouse | | | |
| 3.3 | | | Other | | | |
| 4.1 | Regular | | Head | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | employment | | | | | |
| 4.2 | | | Spouse | | | |
| 4.3 | | | Other | | | |
| 5.1 | Casual employment (Agricultural related) | | Head | | | |
| 5.2 | | | Spouse | | | |
| 5.3 | | | Other | | | |
| 6.1 | Casual employment (Non-agricultural related) | | Head | | | |
| 6.2 | | | Spouse | | | |
| 6.3 | | | Other | | | |
| 7.1 | Running own business | | Head | | | |
| 7.2 | | | Spouse | | | |
| 7.3 | | | Other | | | |
| 8.1 | Remittances from family members | | Head | | | |
| 8.2 | | | Spouse | | | |
| 8.3 | | | Other | | | |
| 9.1 | Remittances from non family members | | Head | | | |
| 9.2 | | | Spouse | | | |
| 9.3 | | | Other | | | |
| 10.1 | | | Head | | | |
| 10.2 | | | Spouse | | | |
| 10.3 | | | Other | | | |

| |
|---|
| 1Regularity of income sources: 1=do not get, 2=Occasionally, 3=Regularly, 4=all the time |
| 2Importance of source: 1=Not important, 2=moderately important, 3=Highly important, 4=very important |
| 2. At any time last year (last 12months), did you or anyone in the household do any day labour for income? 0=No, 1=Yes |
| 3. Do you have savings? 0=No, 1=Yes |
| 4. If yes, how often do you save money? 1=occasionally, 2=regularly , 3=Always |
| J (2) Household Food Security |
| 1. Number of months that harvest lasted: |

In the 2009 season, how long did your harvest of the most important cereal and legume crops lasted?

| Row | (a) Crop | (b) Name of Crop | ( c) How long did the harvest last? (no. of months out of 12) 2009 | (d) How long do you think your harvest will last this time? (no. of months) |
|---|---|---|---|---|
| 1 | Most important Cereal crop | | | |
| 2 | Most important legume crop | | | |
| 3 | Most important root/tuber crop | | | |
| | 2. In the past 12months, were there months in which you did not have enough food to meet your family's needs? 0=No, 1=Yes (if no, go to section J3) | | | |

3. If yes, which were the months in the last 12 months that you did not have enough food to meet your family's needs?

| Row | Month | (a) Did you have enough food to meet your family's needs? 0=No, 1=Yes |
|---|---|---|
| 7 | July | |
| 8 | August | |
| 9 | September | |
| 10 | October | |
| 11 | November | |
| 12 | December | |
| 1 | January | |
| 2 | February | |
| 3 | March | |
| 4 | April | |
| 5 | May | |
| 6 | June | |

4. Coping with food shortage

If you faced any food shortage in the past 12 months, what coping strategies did you use?

| Row | Coping mechanism | (a) Did it happen/ 1=Yes, 0 = No | (b) If you used strategy, how often did you use |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | | | it?1 |
| 1 | Borrowed money to buy food or got food on credit | | |
| 2 | Reduced the number of meals | | |
| 3 | Mother ate less | | |
| 4 | Father ate less | | |
| 5 | Children ate less | | |
| 6 | Substituted commonly bought foods with cheaper kind | | |
| 7 | Modified cooking method | | |
| 8 | Mortgaged/sold assets | | |
| 9 | Borrowed from neighbours | | |
| | Coping with food shortages. NB: Not asked in baseline so ask for recall | | |

| Row | Coping mechanism | 2008 | 2010 | 2008 | 2010 |
|---|---|---|---|---|---|
| 1 | Went for food for work programs | | | | |
| 2 | Government programs | | | | |
| 3 | Begging | | | | |
| | 1How often: 1=Very few times, 2=Occasionally, 3=Regularly, 4=all the time | | | | |

J (3) Household dietary diversity

In the last 24hours has your household consumed any of the following foods?

| Row | Food | Types of foods | Has your household consumed? 1=Yes, 0=No | How many days in the last 30days have you consumed this food? |
|---|---|---|---|---|
| 1 | Cereals | Any local foods, egugali, nshima, bread, rice noodles, biscuits or any other foods made from millet, sorghum, maize, rice, wheat or other local grains | | |
| 2 | Vitamin rich | pumpkin, carrots, squash or | | |

| | | | | |
|---|---|---|---|---|
| | vegetables and tubers | sweet potatoes that are yellow or orange inside + other locally available vitamin A rich vegetables | | |
| 3 | White tubers and roots | white potatoes, white yams, cassava or foods made from roots | | |
| 4 | Dark green leafy vegetables | sweet pepper, dark green/leafy vegetables, including wild ones + other locally available vitamin A rich leaves such as cassava leaves etc | | |
| 5 | Other vegetables | Other vegetables, including wild vegetables | | |
| 6 | Vitamin richfruits | Ripe mangoes, papayas, other locally available vitamin A rich fruits | | |
| 7 | Other fruits | Other fruits including wild fruits | | |
| 8 | Meat | Beef, pork, lamb, goat, rabbit, wild game, chicken, duck or other birds, liver kidney, heart or other organ meant or bloodbased foods | | |
| 9 | Eggs | Eggs | | |
| 10 | Fish | Fresh or dried fish or shellfish | | |
| 11 | Legumes, nuts and seeds | Beans, peas, lentils, nuts, seeds or foods made from these | | |
| 12 | Milk and milk products | milk cheese, yoghurt or other milk products | | |
| 13 | Oils and fats | oil, fats or butter added to ffod or used for cooking | | |
| 14 | Sweets | sugar, honey, sweetended soda or sugary foods such as chocolates, sweets or candies | | |
| 15 | Spices, caffein or alcohol beverages | spices, coffee, tea, alcohol beverages or local examples | | |
| 16 | Did you or any in your household eat everything (meal or snack) | | | |

| | | | | |
|---|---|---|---|---|
| | outside of the home yesterday? | | | |

| J (4) Household Assets | | | | | | | |
|---|---|---|---|---|---|---|---|
| Row | Equipment | (a ) Does your HH own ? Yes = 1, No=0 (if no go to next asset) | (If yes, Total Number | ( c) No under joint ownership | (d) No owned by male spouse: What is the estimated amount that you have got from this source in the last 12 months (currency) | ( e ) No. owned by female spouse | (f) No. Owned by other HH members |
| **A** | **Agricultural enterprises equipment** | | | | | | |
| a1 | Hoes, cutlasses, machetes | | | | | | |
| a2 | Ox-ploughs | | | | | | |
| a3 | Draft cattle | | | | | | |
| a4 | Draft donkeys | | | | | | |
| a5 | Tractor/tractor plough | | | | | | |
| a6 | Wheelbarrows | | | | | | |
| a7 | Farm equipment | | | | | | |
| a8 | Water pumps | | | | | | |
| a9 | Sprayers | | | | | | |
| a10 | | | | | | | |
| **B** | **Non-agricultural enterprise equipment** | | | | | | |
| b1 | Sewing machine | | | | | | |
| b2 | Ox-cart | | | | | | |
| b3 | Car | | | | | | |
| b4 | Bicycle | | | | | | |
| b5 | Motorcycle | | | | | | |
| b6 | Radio | | | | | | |
| b7 | Television | | | | | | |
| b8 | Fishing boat | | | | | | |
| b9 | Mobil phone | | | | | | |
| b10 | Paraffin stove | | | | | | |
| b11 | Sofa chairs | | | | | | |
| b12 | | | | | | | |

| **K. OTHER IDENTIFICATION DETAILS** |
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