

**EFFECTS OF ADOPTION OF *STRIGA* RESISTANT MAIZE PRODUCTION
TECHNOLOGIES ON FARMERS' LIVELIHOOD IN KAJURU LOCAL
GOVERNMENT AREA, KADUNA STATE, NIGERIA**

BY

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M.Sc/Agric/46297/2012-2013**

**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES,
AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN
AGRICULTURAL EXTENSION AND RURAL SOCIOLOGY**

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JANUARY, 2015

DECLARATION

I hereby declare that the work in the thesis titled “**Effects of Adoption of *Striga* Resistant Maize Production Technologies on farmers’ livelihood in Kajuru Local Government Area, Kaduna State, Nigeria**”, has been written by me and it is a record of my own 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.

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CERTIFICATION

The thesis “**Effects of Adoption of *Striga* Resistant Maize Production Technologies on farmers’ livelihood in Kajuru Local Government Area, Kaduna State, Nigeria**” by **Aloko**, Ayodeji Bamidele meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to my wife, Mrs Olubunmi Aloko and my lovely children,
Samuel Aloko, Rebecca Aloko and Phoebe Aloko

ACKNOWLEDGEMENTS

I thank God for His protection, provision, wisdom and strength to complete this study.

My profound gratitude goes to my supervisors Professor J, G. Akpoko and Dr M.W.Musa for their painstaking efforts in providing scholarly guidance in the execution of this work. I am most grateful to Mr Sunday Omodona who encouraged me to register for this degree. My heartfelt gratitude and appreciation goes to Mr N.M, jolly, Mrs Helen Joseph, Mr M.A. Owa, Mr M.A Olokundun, Mr George Okorie, Mr Ezekie Marcus and the entire staff of 2nd Ecwa schools Ibrahim Taiwo, Kaduna, for their words of encouragement and prayers.

I wish to express my sincere thanks to all the staff and colleagues in the Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria. The interaction I enjoyed among them made a great success of this work. To all staff of the Zonal Agricultural Development Project (ADP) Barnawa and Kajuru, Kaduna state, and those too many to mention by names, who contributed in no small way to the vision and fulfillment of this thesis I say thank you.

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ABSTRACT

The broad objective of this study was to assess the effects of adoption of *striga* resistant maize production technologies on farmers' livelihood in Kajuru Local Government Area of Kaduna State. The study was conducted in three communities namely: Kasua Magani, Dutsen Gaiya and Kufana. Primary data for the study were collected using well structured questionnaires administered to 120 adopters and 120 non- adopters of *striga* resistant maize production technologies farmers who were randomly selected; making a total of 240 respondents. The data collected were on improved *striga* resistant maize production technologies recommended practices such as, good land preparation, seed dressing, time of planting, seed rate, plant spacing, rate of inorganic fertilizer, organic manure and maize output, farm income and standard of living of the farmers. Descriptive statistics, Chow test and multiple regression analysis were used to analyze the data. Results show that the level of adoption of technologies practices was high; fertilizer application was adopted most while weeding had the least adoption. Kaduna Development Project extension agents were reported as the major source of information on the technologies while the least information came through adopters' friends. Age, marital status, extension contact, social organization and labour were positive and significant at 1% showing a direct influence on the adoption of *striga* resistant maize production technologies. Chow test analysis revealed that chow-F calculated was greater than F distribution indicating that the *striga* resistant maize production technology had effects in the lives of the adopters in term of their maize outputs, income and standard of living. Lack of money was mentioned among many other myriad problems as a constraint in achieving maximum production.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Agriculture was the leading sector in the 1950's and 1960's. In terms of contribution to the economy, it accounted for 63% of the Gross Domestic Product (GDP), in 1960 – 1964, 54% of the GDP in 1965 – 1969 (Aigbokan, 2001). According to Balogun (2001) agriculture accounted for about 65% - 69% of the total exports and decline to about 40% in 1970. By 1996, agricultural export accounted for less than 2% of the export.

Maize (*Zea mays*. L) is one of the important agricultural products and is the most important cereal crop in sub-Saharan Africa (Babaleye *et al.*, 2002). Maize ranks second following wheat in the world's production of cereals. In 1989, the world production was 470.3 million metric tonnes from 129.6 million hectares with an average yield of 3.627kg/ha. Out of this, 36.4 million metric tonnes was produced in Africa. In West and Central Africa, the importance of maize is on the increase (Balogun, 2001). It is the most widely cultivated crop in the region, from the humid rainforest zone to the semi and Sudan Savannah and even the Sahel and from sea level to over 2000 metres altitude where over 5 million hectares are grown (Fajemisin, 1992). In 1994, the estimated total production of maize in Nigeria was 6.90 million metric tonnes from an estimated area of 5.43 million hectares of land (Lagoke *et al.*, 1997). Maize production is currently attracting more attention than the more traditional cereal crops, such as sorghum and millet in subsistence farming systems in Northern Nigeria. This is attributed to increased demand for maize for the preparation of various food items and industrial purposes. Unfortunately, increased production has been constrained by a number of abiotic and biotic factors including *striga* (Lagoke *et al.*, 1997).

Striga reduces the yield of maize by up to 100% when infection occurs at an early stage (Lagoke *et al.*, 1997; Kureh, 2003). Research activities for the control of *Striga* in maize which have been in progress for decades have started to produce positive results (Lagoke *et al.*, 1997; Kureh *et al.*, 2003; Babaleye *et al.*, 2002).

1.2 Problem Statement

The agricultural sector has a multiplier effect on any nation's socio-economic and industrial fabric because of the multifunctional nature of agriculture (Ogen, 2007). A strong and an efficient agricultural sector would enable a country to feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. However, the agricultural sector suffered neglect during the hey-days of the oil boom in the 1970s. Ever since then Nigeria has been witnessing extreme poverty and the insufficiency of basic food items. Hence, the roots of the crisis in the Nigerian economy lie in the neglect of agriculture and the increased dependence on a mono-cultural economy based on oil. The agricultural sector now accounts for less than 5% of Nigeria's gross domestic product (GDP) (Olagbaju and Falola, 1996).

Maize remains the favorite of the African farmers because it is the first "insurance" food crop against hunger at the beginning of the rainy season (Babaleye *et al.*, 2002). Its production is however being threatened by *striga* spp. Hassan (2006) observed that *striga*, called "*Wuta-Wuta*" in Hausa, has been a limiting factor in agricultural development in northern Nigeria. It has brought poverty, low yields and hunger to so many homes and communities due to high infestation of *striga*, on most of the farmland. The way out of this agricultural disaster was not forthcoming so farmers abandoned their lands due to heavy *striga* infestation.

According to farmers and agricultural extension workers during the village analysis surveys, maize cultivation ranked first (about 40%) over other staple food crops like sorghum, millet, rice and cowpea in the past years but now this trend has been reversed because of the *striga* infestation. Some of the problems mostly complained by farmers in the study area include; *striga* infestation, poor soil fertility, lack of fertilizer, and lack of improved seeds (Kureh *et al.*, 2003). A major breakthrough has however, been recorded on the control of this stubborn weed through the development of *striga* resistant maize varieties by scientists at International Institute of Tropical Agriculture (IITA), Ibadan in collaboration with scientists from the Institute for Agricultural Research (IAR), Samaru, Zaria (Babaleye *et al.*, 2002). The parasitic weed (*striga* specie) problem is endemic in the study area.

The first effort at combating this menace was the dissemination of *striga* resistant maize variety seeds (ACR 94 TZE Comp 5-W, WD-STR and ACR-97 TZL Comp 1-W) under an Integrated *Striga* Control (ISC) technology packages in 2002 and 2003 by the Kaduna State Agricultural Development Project (KADP) in Kasuwan Magani. According to Franke *et al.* (2006) out of 148 participating lead farmers; 56 farmers were based in 10 communities near Kachia and Kasuwan Magani (10° 24N, 7° 42 E), town in Southern Kaduna State. The trickle-down effect of ISC technology from lead farmers to secondary farmers continued and in 2004, more *striga* resistance maize variety seeds were distributed to the farmers in the study area (Franke *et al.*, 2006). The *striga* resistant maize seeds are usually adopted along with the recommended maize production practices, particularly for the open pollinated such as ridging, planting, seed rate, spacing, seed treatment, fertilizer application, weeding, pest and disease control, harvesting and storage.

Majority of studies on the effects of agricultural research have been carried out within conventional economic frameworks such as benefit-cost analysis, economic surplus models,

and economic efficiency estimation (Norton and Davis 1981; Jahnke *et al.*, 1987; Adesina and Zinnah, 1992). Within such economic frameworks, little or no attention is given to the actual social effects of technology, that is, the effects of technology on the lives of people, their welfare, their nutritional status, their gender relations, and other social processes in the community. Effects on the lives of resource-poor farmers is probably the most functional benefit of agricultural technologies, and the dominant preoccupation of stakeholders (Jahnke *et al.*, 1987; Collinson and Tollens, 1994). There is thus a strong need to focus on the social effects of agricultural technologies in sub-Saharan Africa where social concerns are higher and more pressing than anywhere else in the world (Derman and Whiteford, 1985; Demery *et al.*, 1993).

In spite of numerous extension efforts, not much attention has been given to the study of effects of adoption of the *striga* resistance maize production technologies introduced to the farmers to ascertain the level of maize output, farm income and standard of living of the farmers in the study area. This study was aimed at bridging this knowledge gap through addressing the following research questions:

- i. What are the socio-economic characteristics of adopters and non-adopters of *striga* resistant maize production technologies?
- ii. What is the level of adoption of the *striga* resistant maize production technologies in the area?
- iii. What are the sources of information on *striga* resistant maize production technologies?
- iv. What are the soil management practices adopted along with *striga* resistant maize production technologies?

- v. What are the effects of adoption of *striga* resistant maize production technologies on maize output, income from maize production and standard of living of adopters?
- vi. What are the factors influencing the adoption of *striga* resistant maize production technologies?
- vii. What are the constraints associated with adoption of *striga* resistant maize production technologies in the area?

1.3 Objectives of the Study

The broad objective of the study was to assess the effects of adoption of *striga* resistant maize production technologies in Kajuru Local Government Area of Kaduna State. The specific objectives were to:

- i. describe the socio-economic characteristics of adopters and non-adopters of *striga* resistant maize production technologies;
- ii. identify the level of adoption of *striga* resistant maize production technologies in the area,
- iii. identify the sources of information on *striga* resistant maize production technologies,
- iv. examine the soil management practices adopted along with *striga* resistant maize production technologies;
- v. assess the effects of adoption of *striga* resistant maize production technologies on maize output, farm income and standard of living of adopters;
- vi. determine the factors influencing adoption of *striga* resistant maize

production technologies, and

vii. examine the constraints to adoption of *striga* resistant maize production

technologies in the study area.

1.4 Justification of the Study

The goal of agricultural research centers such as the International Institute of Tropical Agriculture (IITA) Ibadan is to generate technologies for improving productivity, farmers' welfare, and household nutritional status. In recent years, there has been growing concern to assess the effects of adoption of agricultural research at farmers' level to determine who benefits from technological change and in what specific ways at both the small-scale and societal levels (Ogen, 2007). The devastation of farmlands by *striga* calls for concern as the problem has led to enormous and drastic reduction in crop yields and increased losses thereby threatening the livelihood of thousands of subsistence farmers who depend on the major food crops cereals. The development of sustainable technologies in *striga* control by IITA (Ibadan) and IAR Samaru (Zaria) has improved maize production in the savannah zones of Nigeria (Lagoke *et al.*, 1997; Babaleye *et al.*, 2002).

Empirical studies on the effects of adoption of *striga* resistant maize varieties are few with more attention on field trials. This study is aimed at bridging this gap which could be used by policy-makers to formulate policy that would help improve food security in the country. It would help to encourage researchers in going into more researches to achieve better *striga* resistant maize varieties. The information from this study would enable agricultural extension agents to convince farmers having similar problems of *striga* infestation about the benefits of

adopting the technologies. Donor agencies could take advantage of the effects of adoption of *striga* resistant maize production technologies on maize production output, income of farmers and living standards of the people to fund more projects in their efforts towards food security in Nigeria.

1.5 Hypotheses of the Study

The hypotheses tested in this study were:

- i. There is no significant difference in the maize outputs between adopters and non-adopters of *striga* resistant maize production technologies in the study area.
- ii. There is no significant difference in incomes between adopters and non-adopters of *striga* resistant maize production technologies in the study area.
- iii. There is no significant difference in standard of living between adopters and non-adopters of *striga* resistant maize production technologies in the study area.
- iv. Farmers' socio- economic and institutional factors have no significant effects on adoption of *striga* resistant maize production technologies in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Ecological Requirement of Maize (*Zea mays* L)

Maize (*Zea mays* L) is well adapted to a wide range of environmental conditions. It is grown in latitude 48°N to 4°S world over. It is a warm season crop requiring considerable moisture and warmth from the time of planting to the end of the flowering period. Favourable temperature for germination is 17.3°C (Fakorede *et al.*, 1993). In semi arid areas, high temperatures, accompanied by deficient moisture is injurious to the crop. A combination of high temperatures and low humidity may kill the leaves, tassels and prevent pollination (Fakorede *et al.*, 1993).

Irregularity and insufficient rainfall together with low and declining soil fertility are key environmental factors against maize production (Fajemisin, 1992). Maize requires ideal fertile well drained aerated loamy soil containing abundant organic matter well supplied with available nutrients. Clay and sandy soils are not very conducive for its growth. It does well in soils with PH 6.0 – 7.0 and a rainfall requirement of 500mm – 1500/annum (Fakorede *et al.*, 1993).

2.2 Socio-economic Characteristics of Farmers

It is evidenced that the socio-economic characteristics of farmers play important role in agricultural development. Many past studies have demonstrated that personal characteristics of farmers affects their decision on adoption and have largely been found to include age, farm size, family size, mental flexibility, farm ownership, other occupation, frequency of agents – farmer contact, social status, level of living, exposure to mass communication media and other socio-economic factors (Adesina *et al.*, 2000).Also Atala (1998) found that socio-economic factors such as formal education, cosmopolitanisms and community status were related to adoption.

Family size means the total number of people in the household who resides within the same family and eats from the same pot (Saleh, 2006). Household size is the main source of farm labour in Northern Nigeria. Labour constraints affect a farmer's choice of technology (Feder *et al.*, 1985) and can constrain the adoption of a labour demand technology (Dvorak, 1996). According to Chianu and Tsuji (2004) large family sizes are more likely to adopt some soil improvement technology due to sufficient labour. In societies where little mechanization is practiced, most economic productions are carried out manually. Thus, the greater the number of hands available, the greater the productivity of the family (Ekong, 2003).

In Africa where farming is mainly dependent on family labour, the unmarried often lack the necessary farm help operations especially in gender performed tasks. The unmarried will more likely be dependent on hired labour and communal cooperative work (Jolly, 2008).Household size is affected by the need for manual labour. Women work alongside their farming husbands

in the planting and harvesting of grains, root and tuber crops. Thereafter they pound and process grains, fetch water, smoke and dry fish or bush meat (Ekong, 2003).

The age of an individual as measured in years is believed to be capable of influencing the perception, views, interest and conduct of the person (Chianu and Tsuji, 2004). Many studies have linked innovativeness with young age (Akpoko, 2004). Young people are taught to be more receptive to modern ideas than older ones, that are negative, relationship between age and adoption (Agwu, 2004). Erwin (1981) found that the probability of adoption of soil conservation practices was lower among older farmers because of their shorter planning horizon. Jan (1986), observed that children in the rural areas engage in economic activities from a very early age while urban children start usually later. However, the age of retirement is generally open ended since very few people have access to a formal social security system. Studies have consistently shown that there are more males of active productive age in the rural areas than females. This is a reflection of the fact that females play minimal roles in farming (Ekong, 2003).

There is a universal assumption that formal education facilitates learning and as such those farmers who have attended school would under normal circumstances have a more favorable attitude towards adoption of improved farming practices (Osuji, 1983). Education improves human capital, farm management capacity and ability to understand and adopt new agricultural technologies (Bezuayehu *et al.*, 2002). It is expected that better educated farmers are more likely to adopt technologies than less educated (Chianu and Tsuji, 2004). Education means the acquisition of knowledge through formal or informal means.

In his study of Columbian farmers, Rogers (1995), found that one partial indicator of excellence in farming is farm size. He found that there was low but positive correlation between farm size and adoption of agricultural technologies. Similarly, Cameron (1999) reported a positive relation between farm size and adoption of improved agricultural technologies. However, Caswell *et al.* (2001) noted that farm size is not a significant factor in explaining adoption. Similarly, Ogunfeditimi (1986) found negative relationship. The size of holding is not only surrogating for other more important factors such as improved technologies (Feder *et al.*, 1985).

Agricultural extension played a major role in the popularity of chemical fertilizer in Northern Nigeria (Smith *et al.*, 1994). Contact with extension enables farmers to obtain information on improved agricultural technology (Dvorak, 1996). Personal contact or face to face communication between extension workers and farmers has been described as the most important instrument for arousing interest and for teaching related farming skills (Caswell, 2001). Extension service serves as effective channel through which information is passed onto farmers (D'Silver and Raza, 1984).

Farmers' diversity of knowledge has an influence on adoption of technology. Chamale (1987) found that there was no significant relationship between stubble mulching and reduced tillage on one hand and fertilizer use on the other. He found that soil conservation index correlated significantly with adoption of fertilizer. It was found that farmers' knowledge of improved practices such as chemical fertilizer application, planting, spacing made significant contribution to adoption of those groundnut production recommendations in the Gambia (Jagne and Patel, 1981). Williams *et al.* (1984) recognized leadership structure in a community as a factor on the approval of formal and informal leaders.

Membership of social Organization refers to social participation in organization which enhances interaction and exposes farmers to information about improved farm practices thereby high success rates when they work in groups (Versteeg and Koudokponm, 1993). Credit is often used to promote adoption of agricultural innovations (Ahmed *et al.*, 2002). Without credit, most farmers cannot afford recommended inputs because the income of small scale farmers is very low in Nigeria (Chianu and Tsuji, 2004). They also said that there is positive relationship between access to credit and decision to adopt innovations. Anderson *et al.* (1984) found amount of credit received to be associated with higher degree of soil conservation. This suggests that individuals with low income and inability to obtain credit for conservation investments may not be willing to adopt soil conservation techniques.

One of the most important determinants of the outcome of the innovation-decision process is the adopters' perception of the attributes of innovations (Akpoko, 2004). Perception refers to respondents' view of the innovations (Rogers, 1995). He went further to add that the perceived cost and compatibility of the technology are the determinants of adoption behaviour in the innovation decision model. Agbamu (1995) reported that if farmers' knowledge in environmental management is increased they will likely adopt more of the practices. Arokoyo (1992) remarked that mobilization, farmers' perception and participation are the key to the success of any plan/strategy.

2.3 Adoption of Technologies

Awareness of improved agricultural technologies is the first stage in the adoption process (Ekong 2003). This is the stage where an individual or group first learns about the existence of a technology. Study by Feder (1993) reported that lack of awareness of agricultural technologies and poor dissemination of technical information are significantly related to number of extension agents. Feder (1993) also indicated that awareness depends on the number and type of information sources used by the farmers. Farmers' awareness and adoption behaviour is a function of socio-economic, socio-cultural and institutional factors such as farm size, age, level of formal education, income, household size and frequency of extension contact (Okwoche, 1998).

Among the various factors influencing adoption therefore, are age, education level, farm size, income, values, norms, cultural beliefs, contact with extension, cost and economic feasibility of innovation, complexity, social status, personal characteristics and nature of the community. Atala (1980) found that socio-economic factors such as age, household size, formal education, farm size, and income and community status were related to uptake of technologies. Okwoche (1998) found a positive and significant relationship for age, household size, farm size, farm income and non farm income with adoption of productivity enhancing innovations. Osuji (1980) in his own study studied the infrastructural facilities affecting the adoption of new farm practices in Imo State of Nigeria. He found age, education, income and frequency of contact with extension agent to have a positive correlation with adoption.

Educational levels of farmers affect adoption of innovations. According to Obibuaku (1983) low standard of education among farmers means that such farmers would tend to adopt improve farming. Adoption is also affected by farm size. A large size provides farmers with opportunities for increased use of land in introducing new innovations. Small and fragmented

farmland limits introduction of technologies e.g. mechanized farming. Nweke (1981) found a positive relationship between number of years of education and agricultural progressiveness. He stated that an educated farmer is less skeptical of a new idea and is more able to evaluate available information on improved practices.

Voh (1982) found, for instance, that education had a significant association with adoption of innovation among some farmers from Northern Nigeria. In another study done in Anambra and Imo States of Nigeria, Uwakah (1980) found a positive correlation between level of education and response to innovation campaigns. In a similar vein, Nweke's (1981) survey of farmers' adoption pattern in some farm communities in Anambra State established that literacy was a very significant determinant of progress in agriculture. Number of years spent in formal education is one of important determinants of intensity of adoption. Education catalyses the process of information flow and leads the farmer to as wide as possible, the different pathways of getting information about a technology.

The more information pathways the farmer has, the more the farmer intensifies adoption. Indeed, studies of innovation adoption and diffusion have long recognized information as a key variable, and its availability is typically found to correlate with adoption (de Harrera and Sain, 1999). Information becomes especially important as the degree of complexity of the conservation technology increases (Nowak, 1987). Agbamu (1995) indicated that contact alone will not promote adoption if information dissemination is ineffective, inaccurate or inappropriate. Information sources that positively influence the adoption of technologies can include: other farmers; media; meetings and extension officers. Studies have not always shown that the ease of obtaining information correlates with adoption. Saha *et al.* (1994) stressed the fundamental role played by the quality of information on the decision to adopt or not and on

the intensity of adoption of a new technology in a context where adoption is divisible and significant risks are present. Ersado (2001) reported adoption of more technologies - intensity of adoption - increases as household head education level increases.

Gender (sex) affects adopting, for example men are more sensitive to innovations that favour them while women are more innovative to women programmes e.g. Home economics. Age affects adoption. According to Obibuaku (1983) high incidence of old people in a population might tend to militate against the extension worker's efforts to improve agriculture in the area because older people are less receptive to new ideas and are less inclined to accept farm innovations than young ones. Ersado (2001) observed that female headed households have positively influenced adoption lag of water system innovation. This is attributed to decision making mechanisms which seem to be weak in female heads of households. He also, found out that among other factors that influence adoption of innovation in Ethiopia, the age of the head of household and education level were found to be positively and significantly affecting the probability of sequencing choices – adoption lag. The higher the frequency to attend collective activities the higher the time lag to adopt.

Income level of farmers affects adoption. Some innovations require inputs which may be beyond the farmers' financial capability. The farmer can therefore go for innovations that are cheap but with high pay-off. Values, norms, cultural and religious beliefs of a farmer affect adoption. Extension must teach farmers the correct technology based on their needs, and goals. Technologies must not conflict with farmers' culture and religious beliefs. Farmers' level of contact with extension affects adoption. In their own study Caswell *et al.* (2001) not only found the extension agent to be an important source, but also found a significant association between farmers' adoption index and their frequency of contact with extension. They also

established that the use of the mass media, size of farm and level of education were all positively associated with adoption. Improved practices that cost little but with high pay off will be more widely accepted by farmers than those practices requiring large capital investment.

Complexity of an innovation affects adoption. If an innovation is visible, and easy to follow, it is more likely to be accepted for adoption. An individual's status, prestige and personal characteristics in the community affect his level of interaction. Individuals with high social status tend to be more innovative. The social nature of a community affects changes. Communities with norms that are more favorably disposed towards innovativeness tend to accept innovations (Williams, 1984). Rogers (1983) stated that the perceived cost and compatibility of innovations are key determinants in the adoption decision process model. Agbamu (1995) reported that when farmers find recommended farm innovation not to be technically feasible, economically viable and culturally compatible, they often reject such innovation. Mokonnen (1991) in a similar vein stated that farmers often reject innovation when innovations are inappropriate or unrelated to their needs and problems.

Feder (1993) in discussing economic development notes the absence of entrepreneurship and willingness to accept innovation as a source of resistance to change. Cameron (1999) described lack of socialization in early childhood of key social values such as achievement and autonomy as barriers causing resistance to adoption. Osuji (1983) stated that group solidarity is another factor affecting adoption. Ekong (2003) remarked that rejection of outsiders is another source of resistance to change caused by a high degree of in-group identification. Cameron (1999) identifies other constraints to adoption are fear of risk and uncertainties, fear of consequences, desire to preserve traditional ways and general unwillingness to change.

Fujisaka (1991) went further to add some constraints to adoption as, absence of problem, inappropriate innovations, incorrect identification of adoption domain, local practices better and poor extension. Caswell *et al.* (1963) stated that farmer difficulty in comprehending cause and effects relationship of his agricultural problems.

2.4 Rate and Level of Adoption of Recommended Agricultural Practices

The rate of adoption is defined as the relative speed with which member of a social system adopt an innovation. It's usually measured by the length of time required for a certain percentage of the members of a social system to adopt an innovation (Rogers 1995). The rates of adoption for innovation are determined by an individual's adopter category. In general individuals who first adopt an innovation require a shorter adoption period (adoption process) than late adopters (Ekong, 2003). At the early stages of introduction of a new technology, only few farmers obtain full information about the potential economic benefits of the technology and hence the adoption speed is low (Bera and Kelly, 1990).

Studies by Abadi Ghadim *et al.* (1999) showed that the rate of adoption of a technology is a function of the extent of economic merits (profitability) of the technology, the amount of investment required to adopt the technology and the degree of uncertainty associated with it and availability of the technology. Many adoption studies indicated that, there is great variation in the speed of technology diffusion. It has been argued that potential adopter's perceptions of the attributes of new technology affect the speed with which that technology adopted. A study by Rogers (1983) identified five characteristics of innovations included: Relative advantage, Compatibility, Complexity, Divisibility, and Observability. Another study by Supe (1983) added two more attributes that affect the rate of adoption: Variations in the cost of adoption and Group action requirements of the technology. Relative advantage is regarded as the one with the strongest effect in the rate of adoption. The relative advantage can be

subdivided into economic and non-economic categories. The economic categories are related to the profitability of the technology while the non-economic features are a function of variable including saving of time (leisure) and increase in comfort (Ratz *et al.*, 1995).

Byerlee *et al.* (1986) said that the rate of adoption is a function of five characteristics: profitability, riskiness, divisibility or initial capital requirement, complexity and availability. Menker *et al.* (1997) observed that the rate of adoption of hybrids will depend primary on the economic benefits obtained in the farmer's fields. Within the rate of adoption there is a point at which an innovation reaches critical mass (Rogers, 1983; Gutkind, 1985). According to them, this is a point in time within the adoption curves 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 (1983) outlined several strategies in order to help an innovation reach this stage. These strategies are: have an innovation adopted by a highly respected individual within a social network, creating an instinctive desire for a specific innovation. Inject an innovation into a group of individuals who would readily use an innovation and provide reactions and benefits for early adopters of an innovation.

Rate of adoption is determined by many factors. According to Rogers (1995) perceived attributes of an innovation are one of the most important explanations of the rate of adoption of an innovation. From 49% – 87% of the variance in the rate of adoption is explained by five attributes, which are as under:-

- i. Perceived Attributes of Innovations i.e. relative advantage compatibility, Complexity, Trialability and Observability.

In addition to these five perceived attributes of an innovation. Other variables also affect the rates of adoption of an innovation (Rogers, 1995) which are as follows:

- ii. Types of Innovation – Decision
- iii. Communication Channels
- iv. Nature of the social system
- v. Extent of change agent's promotion efforts.

Suppe (1983) however, said the following factors impede the rate of adoption: characteristics of innovation (economic cost, consistency with values, complexity, etc.), characteristics of adopters (age, education, income, use of information sources, etc.), and constraints of a system (values and norms, authority system, feudalism etc.) Adoption studies also identified and described five categories included innovators, early adopters, early majority, late majority and laggards (Rogers, 1983). Describing the characteristics of these groups a study by Rogers (1983) indicated that the innovators are first adopters of innovation, ready to take risk and young in age. Majority of early adopters are expected to be younger, more educated, venturesome and willing to take risk. In contrary to this group, the late adopters are expected to be older, less educated, conservative and not willing to take risks. However, a study by Runquist (1984) noted that the practical aspect of the classification of adopters into five categories is relevant to deliberate or planned introduction of innovation. The usefulness of this categorization is restricted as there is evidence indicating a movement from one category to the other, depending on the technology introduced. Lowenberg (2000) concluded that the rate of discontinuance was as important as the rate of adoption in determining the level of adoption of an innovation at any particular time.

Level of adoption is defined as the perceived degree, knowledge, utilization, confidence or competence; ranging from “non-use”, through “orientation”, “preparation”, “mechanical

use", "routine", "refinement" and "integration" to "renewal" (Doug, *et al*; 2009). The level of adopting innovations depends on the structure of the society, the standard of life and economic contribution of those innovations. If the innovation has an economic contribution, the speed of its distribution increases (Turkyilmaz *et al.*, 2003). The study concerning the adoption of rice technology conducted by Suhendar (1997) told us that the factors which influence the adoption level of rice technology are land-owning, farmers age, and farmers economic motivation. Obinne (1991) reported that the level of adoption of Improved Cassava Production Technology (ICPT) was significantly higher among farmers in contact with Agricultural Development Project (ADP) than among farmers without such contact.

To determine the different levels of adoption of dairy farming technologies amongst livestock farmers, the described process in which detailed in the research by Nell (1998) was used in modified form. According to Nell (1998) adoption of dairy farming technologies was studied at two levels, Individual and overall adoption behavior, respectively. To study adoption level of each individual, livestock farmers were categorized as adopters and non-adopters. Then according to scores obtained by each individual, adopters were categorized into three groups as partly (score 1), to some extent (score 2) and fully (score 3). The summation of scores of respondents over these technologies plus score of 8 common dairy farming technologies was the overall adoption score of livestock owners in dairy farming technologies. The overall adoption level of farmers formed the basis for the categorization of respondents as high, medium and low level of adoption behavior in respect of farming technologies (Nell, 1998; Cicek *et al.*, 2008). Studies carried out by Cicek *et al.* (2008) showed that approximately 12% of the enterprises adopt innovations at a low level while 65% of them at medium level and 23% of them at a high level. Rezvanfar (2007) studies on level of adoption of livestock showed that the majority of livestock owners (59.09%) of the two groups were found belonging to medium

level of adoption behavior, followed by 22.75 and 18.18 percent livestock owners with high and low level of adoption behavior with respect to dairy farming technologies.

2.5 Effects of Recommended Practices on Farmers' Standard of Living

According to Rogers (1995) respondents were asked to give reasons for the adoption of various recommendations. Many (67%) adopted the innovation for more yield, more than half (55%) did so in order to generate more income for farming and family upkeep, about one quarter (25%) adopted in order to try out new techniques, one fifth (19%) did so because they were convinced of what has been said about the innovation, while 18% did so because they have seen other farmers used it successfully. Gbadegesin *et al.* (2000) in their study on the effect of adoption of improved technology on rice production reported that about 28.9% of the farmers indicated that the adopted of recommended practices has enabled them to purchase bicycles, cars and other capital items, about 26.1% indicated that this has enabled them to build houses and about 19.4% admitted that has led to better nutrition for the family about 7.7% claimed that they have started new business about 10% admitted that it led to provision of better health care to the family which led to increased schooling for children. Also, Hassan (2006) agreed that farmers' income is now improved due to higher yields; family welfare has also improved. More children are now sent to school with better uniforms and looking healthier. Where an improved diet resulted, most respondents (over 80%) indicated that this benefited the entire household; 11% said young children derived most benefit (Ellis-Jones *et al.*, 2006).

The adoption of soybean has had a clear positive effect on household income generation and distribution, material welfare, human capital development, gender relations, resource use, social equity, and other social processes in the community. Many innovations in soybean

utilization have been adopted; to the extent that soybean has become a staple food. The results further showed that the nutritional status of children was significantly better in soybean producing/using households than in those that did not use soybean (Sanginga *et al.*, 1999).

2.6 Constraints Militating against Adoption of Recommended Agricultural Practices

The wealth of Africa depends on her ability to conserve and manage her land resources. It is a well known fact that soil degradation not only results in decreased food production but also in ecological imbalance and consequent degradation of the quality of life (Timberlake, 1985). In Africa the most conspicuous symptoms of the negative impacts of land degradation on food production are stagnating and declining yield and increasing levels of poverty (FAO, 1998). Unless the removed nutrients are replenished adequately, soils cannot be sustained for posterity, and removed nutrients cannot be adequately replenished unless mineral fertilizers are used (IFDC, 1994). It went further to state there is no exaggeration to say that there is no sustainable food security without mineral fertilizers. According to IFDC (1994) fertilizer that was highly subsidized to the tune of 80% in 1990 became scarce and expensive with reduction in government subsidy and lower value of Nigerians currency. He also reported that soils of Nigeria vary greatly in their content of organic matter and total nitrogen, while the practice of bush burning, non incorporation of plant residues into the soil and continuous production of cereals arable and root crops, and rapidly depletes the soil nutrients.

Several decades of nutrient depletion have transformed originally fertile lands into infertile ones where cereal crop yields are less than 1t/ha (Swift *et al.*, 1994). They also reported that fertile red soil lost half their organic nitrogen and phosphorus content in 15 years of continuous crop production without nutrient returns. Pedro *et al.* (1996) gave an elaborate negative impact of farming as crop productivity declines, nutrient depletion leading to less fodder for cattle, less fuel wood, small amount of crop residue and less manure from livestock. These affect increase erosion losses because there is less plant cover to protect it.

Fertilizer recommendation has always been a blanket one for a whole climatic zone without much reference to soil types and soil types and soil testing (IFDC, 1994). Nevertheless despite high cost of inorganic fertilizer and to some extent its unavailability at periods of dare need farmers still broadcast fertilizer on their fields instead of incorporation he added. Though this method of application is cheaper and faster, there are serious economic and environmental implications (Valencia and Breth, 1999). In some cases farmers apply higher dose/rates than recommended while in some cases farmers apply below recommended rates on their field in anticipation of rainfall (Fakorede et al; 1993).

Highlights of recent advances in soil fertility management according to Food and Agriculture Organization (FAO) (1983) and International Institute of Tropical Agriculture (IITA) (1986) include the following innovations: application of organic manure in combination with mineral fertilizer, side placement of fertilizer by burying and inorganic fertilizer use is based on soil test values to avoid fertilizer abuse and nutrient imbalance. Bush burning practices by a large proportion of farmers constitutes a technologically easy answer to the problems of clearing debris from the field prior to planting (Pretty, 1995). Early burning is less destructive than later burning in the dry season and also uncontrolled burning is highly discourages (Mortimore,

1998). The use of light implements for land preparation or bush slashing and manure removal of the biomass to avoid soil compaction is acceptable (Unama, 1991).

Crop rotation are a central component in the direction of resource conserving farming, with the maximum use made of crops that contributes to soil fertility and reduce pest damage (Pretty, 1995). According to Edwards (1993) other advantages are complimentary use of soil nutrients, water holding capacity and infiltration, soil conservation, organic matter restoration, striga control in cereals. The approach is to restore non host crop in sequence. It is a practice that rarely has ecological or economic drawbacks and many farmers regard it as an essential component of prudent management (Pretty, 1995). It is predominantly cereal-legume based with root and tuber crops (Adolph *et al.*, 1993).

Ridging is a common method of controlling soil erosion on farm in the savannah and also ridges across the slope is enough to check soil erosion (Antwi and Asiamah, 1993). In high rainfall areas ridges have the tendency to collect water and being able to serve as drainage, they are basically water conservation devices which have the advantage of providing a deep seed bed (Ratz, 1995). Ridges and/or tied ridging had been evaluated as an improved soil and water management practices to alleviate moisture stress. In a study by Rao *et al.* (1988) shown significant yield increase of sorghum varying from 19% -80% over simple ridging. The study also assessed that manual construction of tied-ridges needs 15 man days per ha and at prevailing cost. Tied ridging gives a benefit cost ratio of 3.3:1 which is attractive for farmers to adopt. While positive effect of tied ridging was observed on sloppy terrace which erosion and run off were high; lack of benefit was associated with relative flat-land (Rao *et al.*, 1988). Light texture soil and well distributed rainfall no benefit was also observed on tied ridges (Singh,

1986 and Rao *et al.*, 1988). Another study on tied ridging (Talleyrand *et al.*, 1988) found that maize, sorghum and millet indicate a positive response and yield increase over simple ridging.

According to Conway *et al.* (1991) the single most important factor contributing to erosion of sloping land is tillage. As a result of clearing the land exposes the soil to the action of weather and repeated tillage erosion. An alternative approach is to use conservation tillage in which the soil surface is disturbed as little as possible (Pretty, 1995). Conservation tillage is a concept of producing crops without cultivating the land with plough or harrow and residues are maintained to serve as much on the soil surface to give at least 30 % coverage (Abara *et al.*, 1978). Rao *et al.* (1988) reported that conservation tillage is accepted worldwide. It is therefore a perfect replacement of shifting cultivation in Africa where expansion of crop land has resulted in rapid deforestation as existing crop land is abandoned due to loss of fertility, soil degradation and severe erosion (Abara *et al.*, 1978). Bremer *et al.* (2001) reported that adoption of Conservation Tillage (CT) and cover crop system for erodible soil offers a practical means of preserving soil productivity.

Soil, water and nutrient conservation is also improved with the use of mulches or cover crops (Pretty, 1995). Similarly, organic or inorganic material is spread on the soil surface to provide a protective cover, the mulch, for the top soil protects it from soil erosion, desiccation and excessive heating. In Guesselbodi, Niger, mulching with twigs and branches permits cultivation on the soils, producing some 450kg cereals per hectare. In drought years, yields on mulch soil are some five times better than soil on non-mulch (Hatibu, 1999). In China, wheat / rice straw mulches can increase tea, fruit and legume yield by 6 – 16%, as well as reduce splash erosion (Jin, 1991). And in the hot Savannah region of Northern Ghana, straw mulches minimize erosion as well as increase yield. Combined with livestock manures these mulches produce

double the maize and sorghum yields than equivalent amount Nitrogen added as inorganic fertilizer (Bonsu, 1983). Cover crops consists of vegetation that is deliberately established after or inter cropped with a main crop, not necessarily with a view to harvest but to serve various regenerative and conserving functions (Pretty, 1995). The adoption of crop-residues mulching by small holders in the sub-humid / sub-tropics often require the creation of an enabling environment through technological or institutional change. One option to enhance the attractiveness of mulch is to link the mulch component to other technological changes that do generate short term productivity boos such as improved varieties and fertilizers or herbicide (Abadi Ghadim et al., 1999).

Cultivars assist soil not to lose its fertility, minimize wind and water erosion and also farmers do not waste their inputs i.e. assist plant in making the best use of applied water and fertilizers (KNARDA, 1996). However, pretty (1995) reported that for small scale farmers, cultivar should be planted on the farm boarder at 20cm spacing while large scale farmers, it should be planted on contour i.e. across the slope. Where rainfall is unreliable and inadequate, water shortage often severely limit crop production. Water conservation and harvesting can carry over an otherwise disastrous dry period, can stabilize and increase production, and can even make agricultural production possible for the first time (Reji *et al.*, 1988). Water harvesting system commonly includes a run-off producing and a run-off using area, water harvesting can be found in many parts of the world (UNEP, 1983; Reji, 1991). Rain water run-offs can be collected and stored from different catchments areas such as ground surfaces, seasonal water courses, building roof, etc. It can be collected and stored in artificial water reservoirs, such as ponds, basins or tanks. From there, the water can be directed to a crop land for crop uses (Antwi *et al.*, 1993). There is no doubt that pesticides are hazardous, at very high dosages many are lethal both to laboratory animals and people and causes several illness at sub lethal levels (Conway

and Pretty, 1991). In Nigeria ignorance and lack of user protection have exacerbated the problems of pest hazard (IFDC, 1994). Most rural farmers handle pesticides which have the disadvantage of low selectivity without caution; endangering themselves, the families, harm both beneficial organisms as well as pest (Hatibu *et al.*, 1999).

Various studies (Abara *et al.*, 1978; Ekong, 2003) have shown that participating farmers encountered several problems associated with the implementation of programme recommendations. These problems could potentially limit the output of production thus affecting the programme goal. The problems range from technology attributes: cost, complexity, compatibility, visibility and divisibility to socio-economic, cultural and political factors among others. According to Fajemisin *et al.* (1997) in their study considered the following critical constraints in adoption of maize technology as follows- the trend of decreasing rainfall duration, erratic rainfall distribution resulting in increased risk of drought stress, low soil fertility, especially low organic matter, increase soil compaction, the attendant low water holding capacity and inappropriate low yielding maize varieties.

Gbadegesin *et al.* (2000) reported that the farmer give various reasons for non adoption of technologies on maize production. With regards to the use of improved varieties, about 59.5% of the farmers complained of scarcity of seeds, 28.7% complained of high cost of seeds, 4.6% said they did not have money to purchase the item, 5.1% complained of adulteration while 2.1% were not aware of availability of improved seeds, lack of fertilizer and price of fertilizer also affects maize production. Lagoke *et al.* (1999) observed that adoption of striga-tolerant hybrids may be limited among the small scale farmers because of high management requirements and cost of production. Maize production is constrained by a host of abiotic and biotic stresses among which are, the parasitic weed-striga, drought, low and declining soil

fertility, diseases, insect pests, poor management practices e.g. use of unimproved and low yielding varieties, low planting densities, inadequate and late application of fertilizer and insufficient and late weeding (Fajemisin, 1992). Maize is very sensitive to attack by striga. The striga incidence is threatening its production in Africa. According to Kureh *et al.* (2003) striga constitutes one of the greatest biotic constraints to cereal production in sub-Sahara Africa with an estimated yield loss of up to 46% in the Guinea Savannah of Nigeria.

2.7 Theoretical Framework

The framework that guided this study is the theory of social change and the perspectives on diffusion and adoption of innovations the human ecology paradigm and impact assessment.

2.7.1 Social change theory

Abadi Ghadim *et al.*(1999) defined theory as a set of inter-related constructs (concepts), definitions and propositions that present a systematic view of phenomena by specifying relations among variables with the purpose of explaining and predicting the phenomena. On the other hand, Ekong (2003) defined social change as the significant alteration of social structures including consequents and manifestations of such structures embodied in norms, values and cultural products and symbols. Abara *et al.* (1993) stressed that essence of human life is change, development and growth. These three words; change, development and growth are often used interchangeably to associate the dynamics of society with progress. The change could be retrogressive which refers to change in an undesirable direction or progressive meaning in a desirable direction. However, Adekoya and Tologbonse (2005) stated that the

only thing that is permanent is change because it is always taking place as everyone adjusts to one thing or the other every time. They went further to add that change can be viewed as a state of dynamism, which precludes stagnation and if well managed and directed ways implies programmes and development.

The theory of social change seek to understand the social reality in which agricultural activities make use of natural resources (soil, water and air) and this have shaped the natural environment and landscape (Bonsu, 1983). Agricultural activities have both beneficial and harmful impacts on the environment through changing the quality or the quantity of locally available natural resources, which are also foundation of natural habitats, biodiversity and landscapes. The foregoing brief description of society change shows clearly how changes have occurred in soil, water and air as a result of mans effort in agricultural activities and efforts embark to mitigate negative impacts (Bonsu, 1983).

Social change is defined as variations or modification in any aspect of social process, pattern or form and as any modification in establishment pattern of inters human relationship and standard of conduct (Gutkind, 1985). Social change involves any change in values, norms, sound ideas, habits, obligations of people or change in life-style, life goals chances and environment or in the composition or organization of their society. Change may occur in the replacement of ideas. In some societies, the scientific techniques of agriculture replace traditional ideas and techniques of farming (Ekong, 2003).

Rogers (1995) defined social change as the process through which alteration occurs in the structure and function of a social system. Social change assumes the introduction of “change material” into a society by the presentation of alternative ideas, practices or choices to change

transform or supplement the existing ones. Information and the communication sources, channels, media and methods by which it is brought to the farmers are of crucial importance in facilitating wide adoption of improved practices as well as fostering the new attitudes involved in the desired change. Social change can be planned or unplanned. Planned change is a conscious, deliberate and intended attempt to bring about change by one or more agents (Ekong, 2003).

In Nigeria, there is a new drive for change and development through the instrumentality of research- extension- farmers' linkage strategy. In this respect and with regard to this study, social change mean change in the way rural farmers engage in farming activities using striga resistant maize technologies and how these activities promote social and economic wellbeing of the rural households.

2.7.2 Diffusion and adoption of innovations

Diffusion is defined as the process by which innovations spread to members of a social system (Rogers, 1983). This process is however, a subject which is more sociological in nature compared with adoption process. Diffusion process according to Anthony (2007) is the spread of new idea, from its source of invention or creation to its ultimate users or adopters (farmers). Daniel (1997) saw it as the process by which an innovation is adopted or gain acceptance by members of a community.

Rogers (1995) defined diffusion as the process by which an innovation is communicated through certain channels over time among member of a social system. According to him a

number of factors interact to influence the diffusion of innovation. These are the innovation itself, communication channels, time and the nature of the soil system in which the innovation is being introduced. Adekoya *et al.* (2005) stated the process of diffusion is a precursor to adopt, although this does not necessarily always end in the latter. However, David and David (2000) reported that adoption and diffusion are the process governing the utilization of innovation.

In another study, Frank (1995) demonstrated that farmers followed an ordered, sequential process over time, and were likely to adopt practices in sets if they offered a means of arresting declining returns per production unit. Farmers made a rational decision not to adopt practices which do not have a socio-economic advantage to them. However, a full understanding of the diffusion process requires an appreciation of the adoption process.

Adoption, according to Adekoya *et al.* (2005) is a mental process, which an individual passes through in deciding to use an innovation. Also Jagne *et al.*, (1981) noted that adoption is synonymous to transfer of technology. He defines transfer of technology as that which embraces all efforts to make sure that the farmers adopts new technology. He emphasized that for transfer of technology to take place, it must embrace input support, advice and other essential so that farmers will have no reasons for rejecting the technology. Before any technology is adopted, it must pass through a process of adoption, which involves, awareness, interest trials, evaluation and adoption. The success of the adoption process depends very much on effective instructor, by extension agents, which is determined by methods and techniques of instruction used (Rogers, 1982; Ekong, 2003; Anthony, 2007).

Innovation can be described as an idea, practice, technology or product perceived as new by an individual. The several characteristics of the innovation as perceived by the receiver contribute to their different rates of adoption. Adoption is the decision of the receiver to make use of the innovation provided it's economically profitable, socially desirable and technologically feasible for the individual to adopt it (Ekong, 2003). In overall, adoption by farmer might not be worthwhile unless the new practices are culturally appropriate, in agreement with self interest, respectful of tradition, clearly beneficial and not economically risky (Fujisaka,1991).Innovations have five characteristics from the farmers point of view which affect their rate of adoption, namely, the innovation must have relative advantage, be compatible, not complex, must be triable and should be observable to be adopted (Anthony, 2007).Adoption is the decision by a farmer to use a technology continuously over a period of time. The time taken for adoption varies with nature of the technology; the communication channels used and the characteristics of the social system. Adoption studies have been seen as important tools for measuring and assessing the impact of agricultural technologies (Rogers, 1995; CIMMYT, 1993; Feder and Umali, 1993). Technology adoption brings potential impact at farm and household levels (Sanginga *et al.*, 1999). All things being equal there exists a significant relationship between level of awareness and adoption of improved technologies.

2.7.3 Empirical findings on adoption and diffusion of innovations

Adoption is a behavioral choice at a particular time and space while diffusion is the adoption pattern over time (Rogers, 1983; Feder, 1993). Agricultural technology adoption has long been of interest to social scientist because of its importance in increasing productivity and efficiency. A review by Ruttan (1977) on several empirical studies on the adoption of green revolution technologies revealed the following generalizations:

1. The new High Yielding Varieties (HYVs) of wheat and rice were adopted at a rapid rate in those areas where they were technically and economically superior to local varieties.
2. Farm size and farm tenure have not been serious constraints on the adoption of new HYVs, and were not important sources of different growth in productivity... this was mainly because productivity of HYVs was approximately the same on small and large farmers' fields.
3. The introduction of new high yielding wheat and rice technology has resulted in an increase demand for labour.
4. Landowners have gained relatively more than tenants and labourers from the adoption of high yielding varieties of wheat and rice.

A study by the Centro Internacional de Mejoramiento de maiz. Y. Trigo (CIMMYT) on maize and wheat in six countries (Kenya, Tunisia, Colombia, El-Salvador, Mexico and Turkey) concluded that the differences in adoption in information acquired differences in farm size and farmers' risks aversion characteristics, agro-climatic and physical environments, availability of inputs and differences in market opportunities for the crops. A comprehensive survey of agricultural technology adoption studies in developing countries by Feder *et al.* (1985) and Feder and Umalí (1993) also found that farm size, risk, human capital, labour availability, access to credit and land tenure systems were the most important factors in influencing farmers decision of technology adoption. Jarvis (1981) indicated that the diffusion of fertilized grass-legumes pasture in Uruguay followed the logistic path during the first years following its introduction. The study considered the number of ranchers borrowing money from the bank for pasture development each year as proxy for new adopters of improved pastures using panel data. Studies by Baseley and Case (1993) and Foster and Rosenzweig (1995) revealed that learning from own experience and learning from neighbours' experience are both important determinants of adoption. These findings are in contrast to earlier investigation by McGuirk

and Mundlak (1991) which showed that adoption was constrained by insufficient fertilizer and irrigation, not by insufficient information. Another study by Cameron (1999) using panel data confirmed that learning is an important variable in the adoption process, cross-sectional estimates of a dynamic process are biased but the extent of this bias may be small, and illustrated methods to estimate the unobserved household heterogeneity in a dynamic model.

Rauniyar and Goode (1996) estimated the interrelationships among technologies already adopted by maize farmers in Swaziland. By applying factor analysis, the study shows that farmers adopted the technologies investigated in three independent packages:

1. Improved maize variety, basal fertilizer and tractor ploughing
2. Topdressing fertilizer, and chemicals and
3. Planting date and plant population (density).

However, the empirical finding did not support sequential adoption. The study explained that farmers in Swaziland tend to adopt packages rather than individual technology component or practices. In contrary to these findings, there are a number of empirical studies supporting sequential adoption pattern (Leather and Smale, 1991). Empirical findings show that timeliness of training is accompanied by increase in adoption of improved crop production technology. It also induces that increase in number of training methods used increased adoption rate (Ofuoku, 2008). Several studies have found that because farmers associations provide both information and credit, membership encourages adoption (Atala, 1998; Ekong, 2003).

2.7.4 Intensity of adoption of technology

Intensity of adoption refers to the number of technologies practiced by the same farmer. The intensity of adoption of different technologies is measured by a variable that represents the breadth of technology use within a particular stage of production. Saha *et al.* (1994)

recognized that producers' adoption intensity is conditional on their knowledge of the new technology and on their decision to adopt. They found that larger and more educated operators are likely to adopt more intensively. Abadi Ghadim (2000) conducted a study that came close to implementing and estimating a complete set of risk impacts related to adoption. Results showed that some determinants of the decision to adopt the innovation are different from those that determine the decision regarding the intensity of adoption. Firms that employ a wide range of advanced technologies - adoption intensity - have mastered a larger skill set and are hypothesized to have shorter adoption lags than those using only one or two technologies (Baldwin and Rafiquzzaman, 1998).

2.7.5 Technology adoption lag

Sociologists describe adoption as a gradual process which involves sequential stages. Researchers have attempted to use these theories to develop models for evaluating adoption path and time lag between the initial awareness about technology to actual use of the innovation by the adopter. Adoption lag refers to the length of delay between a farmer first becoming aware of the existence of a new technology and his/her adoption (Saleh, 2006). Once one has developed the best technical means, it is little wonder that one considers their adoption unquestionably desirable but farmers tend to be a bit recalcitrant. Hence, there tends to be a 'time lag' between the moment at which a farmer learns about an innovation and the time when he or she adopts (de Buck *et al.*, 2001). Abadi Ghadim *et al.* (1999) in their work to develop an expression for explaining the time lag between stages in the adoption concluded that the time lag between awareness and adoption is related to the variance of actual profit. Lindner (1980) assumed that adoption lag is attributed to keenness of farmers to search and learn about new innovation. The second type of adoption studies are temporal studies that are concerned with the determinants of the timing of adoption. A new technology passes through several stages of assessment before it is adopted.

2.7.6 Impact assessment perspectives

Lowenberg (2000) defined impact as the actual programme outcome in relation to the desired outcome intervention. Impact of social intervention can be defined as an output of the organization which is related to the achievement of the programme objectives. Measurement of impact is used in the study of extension by analyzing the perception of clients regarding given services. Objectives assessment on the other hand is commonly used in adoption and diffusion studies. It can be a measure of adoption rate of new technology. Caswell *et al.* (2001) said that the study of the perception of impact helps one to determine the quality of services provided by the organization from the point view of the beneficiaries. Akpoko (2004) stated that the objective of any farming organization is to increase productivity and hence income of the farmers. It is, therefore, imperative to look at the immediate end result of the organization.

Impact of the programme can be seen in relation to what the services actually do to the people who receive them. It has been increasingly realized that new technology alone is insufficient to achieve impact. As a result, many organizations have moved from a primary focus on productivity to include concerns about the environment, poverty, food, and financial security, reflecting a growing understanding that food, eradicating poverty, and protecting natural resources are inseparable goals (Ellis-Jones *et al.*, 2006). Impact is generally concerned with the outcome or effects of an intervention. Ultimately, this means the achievement of project outputs, purposes, and goals, with households improving their livelihoods and assets through a process of community and household empowerment that leads to increased productive capacity and resiliency through a range of interventions (Ellis-Jones *et al.*, 2006).

Rogers (1983) conceptualized effect as the changes that occur within a social system as a result of adoption or rejection of an innovation. As concerns about sustainability of the agricultural production potentials in many poor regions of the world, national and international organizations have initiated research programmes target at developing methods and technologies. These technologies are expected to have effects in resulting in poverty reduction and improving the quality of life of the people (Bekele , 1999).

For the purpose of this study on factors influencing adoption of *striga* resistance maize technologies, considering the efforts made by International Institute of Tropical Agriculture (IITA), Institute for Agricultural Research (IAR) and Kaduna Agricultural Development Project (KADP) in promoting the adoption of maize technologies in the two areas, Kasuwan Magani (Franke *et al.*, 2006) and KADP. It would be envisaged that farmers in the areas have adopted the *striga* resistant maize varieties and the associated recommended practices. Consequently, this perspective will be used to measure the effects of agricultural production, maize output, farm income, and level of living resulting from adoption of *striga* resistant maize technology in the study area.

2.7.7 The Concept of Impact Assessment

The term impact refers to the broad, long-term economic, social and environmental effects resulting from research (IAEG, 1999) while assessment is judging, appraising or determining the worth, value of quality research, in terms of its relevance, effectiveness, efficiency and impact (IAEG, 1999). Impact assessment is a criteria component of agricultural research in that it helps to define priorities of research and facilitate resource allocation among programs,

guide researchers and those involved in technology transfer to have a better understanding of the way new technologies are adopted and diffused into farming communities and show evidence that clients benefit from the research products (Manyong *et al.*, 2001). Impact assessment is an established practice in public goods investment project and programmes such as infrastructure, health, education, transportation and urban development.

Impact studies are of great importance in agricultural research because they are used to identify alternative technologies that would address the major production constraints while at the same time taking into consideration farmers' preferences and farming conditions (Alene *et al.*, 2006). However, they are often evaluated in terms of all the goals and objectives that were set when the project activity or program was established (IAEG, 1999). Thus, it is sad to note that despite the importance attached to agricultural development as a key factor to rural development, literature by (IIED, 1998) has shown that very few impact studies on agricultural development programmes have been undertaken to date.

Impact studies have, however, faced conceptual challenges, partly due to the complexities of the relationship between agricultural technology and the various dimensions of poverty. As the goals of agricultural technology development change from increasing food production to the broader aims of reducing poverty, both technology development and studies of its impact become more complex. Therefore, the context in which new technologies are released and adopted should be in broader definitions of poverty and other socio-economic problems that affect livelihood in a rural environment.

2.7.8 Empirical Findings on Impact Assessment

Empirical findings on Impact Assessment carried out by Bezunel *et al.* (1997) showed that the use of improved, high yielding cultivars and agronomic practices has increased maize yield in Ghana, Mali and Burkina Faso. The returns to investments on maize and its social benefit range up to 150 million dollar per. Annum. Improved Sorghum varieties studies conducted in Chad, Cameroon and Mali shows that adoption of improved varieties has substantially increased production and reduced production costs; Sorghum variety S35 increased from 7% in 1990 to 27% in 1995 in Chad and from 24% to 33% in Cameroon during the same period (Akinola, 1986).

In Pakistan, the total area under fruit cultivation was 672.4 thousand hectares with the yield of approximately 5891.7 thousand tonnes out of which only 259.9 thousand tonnes of fruits were exported which was worth 4575 million rupees (Anonymous, 2001). Cameron (1999) study showed that introduction of large scale, mixed farming which involved the use of ploughs and manure to affect an increase in production of raw materials caused cotton yield from 3,500tonnes to 15,000 tonnes per annum within a period of seven years. Data relating to the impact of the media on adoption revealed a weak degree of association between media exposure and adoption (Uwakah, 1980). Uwakah (1980), studied farmers' response to the Operation Feed the Nation (OFN) campaign in Imo and Anambra States and found a weak correlation between awareness of the OFN innovations and the adoption of the campaigned recommended packages.

2.8 With and Without Impact Methodology

This method of assessment study involves the study of population, villages or communities that benefited from the project and those that do not benefit. It is a method that gives the

researcher a clear difference between beneficiaries and non-beneficiaries, or participants and non-participants. For the purpose of this study, the researcher adopted the with and without project methodology.

Manyong *et al.*(2001) in their view argued that impact assessment of agricultural research is a continuous process and being a process, it better conceptualized as a cycle involving different types of impact studies at different stages using “before and after” impact assessment approach. These researchers based on the technology development process, four stages of impact assessment constitute the impact cycle. These include impact for priority setting (ex-ante impact), on-farm technology evaluation, adoption, ex-post impact.

2.9 Theoretical Model

Akin(1970) defined a model as simply an attempt at classifying the major elements of an entity of phenomenon with regards to their functions and interrelationship, in order to observe more easily how the elements function within the entity. The model shown in figure 2.1 explains the relationship between the socio-economic characteristics of maize farmers which would determine their level of adoption of recommended *striga* resistant maize production technologies which would in turn determine their maize outputs, incomes and standard of living. Therefore, in this model, the first arrow explains the relationship between the independent variables and the dependent variables while the second arrow shows the likely effects of the relationship; which are change in maize outputs, income and standard of living.

Independent

Dependent variables

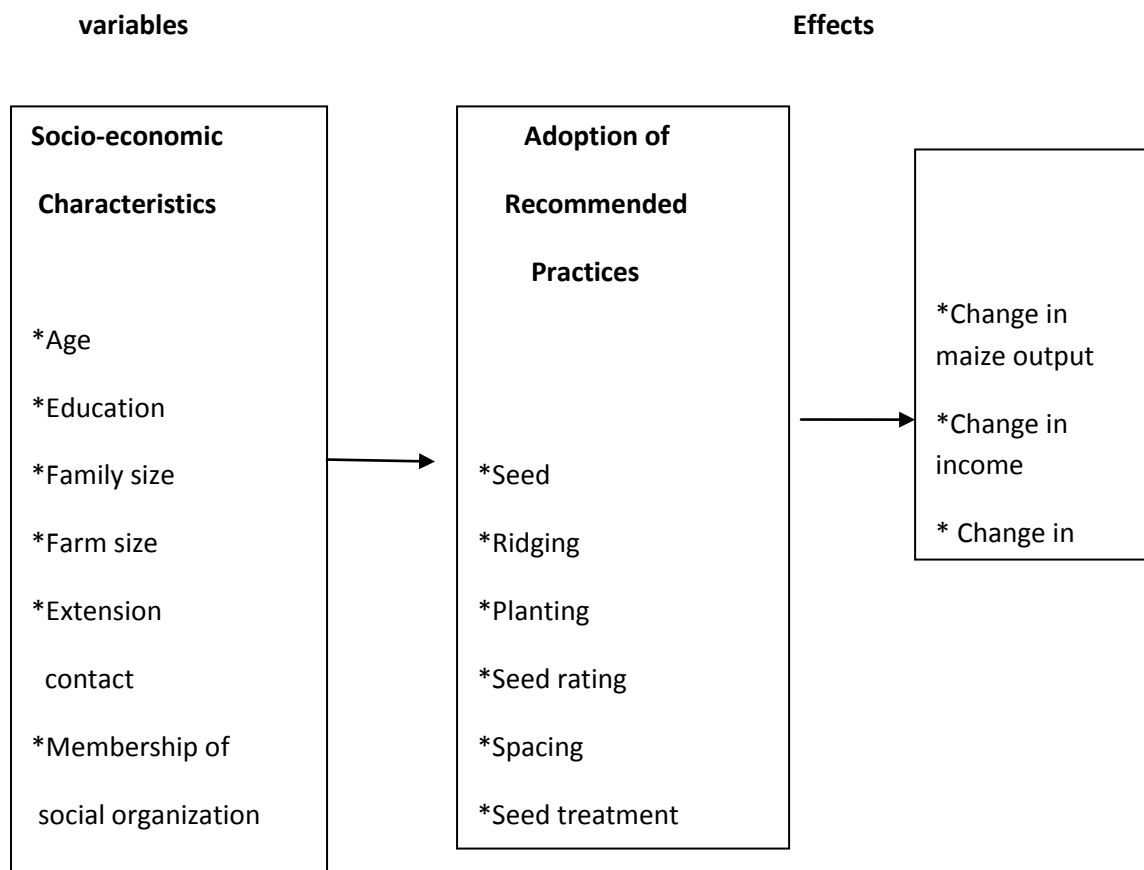


Figure2.1: Model of factors influencing adoption of *striga* resistant maize production technologies in Kajuru Local Government Area

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

The study was conducted in Kajuru Local Government Area (LGA). Kajuru LGA is located between kilometers 28-60 along Kafanchan road in Southern Kaduna, Kaduna State. It was created in March 1995 out of Chikun Local Government Area. It consists of ten wards. These are Kasuwan Magani, Afogo, Maro, Kallah, Rimau, Buda, Idon, Kajuru, Tantatu and Iri ward. It's situated in the Northern Guinea Savannah between longitude 90.59'N and 10. 35'N and latitude 7.34'E and 8.13'E. It shares boundaries with Igabi Local Government Area to the North, Chikun to the East, Zango Kataf to the South East and Kachia Local Government Area to the South.

It has a population of 109,810 people, comprising 54,506 males and 55,304 females (NPC Census, 2006). The projected population of the area using annual growth rate of 3.2% for 2010 is 123,866 people. The land mass is 2072.00 square metre. It has an annual rainfall of 1000-1250mm. Their main economic activity is farming. They produce staple crops like maize, sorghum, millet, rice, early beans, groundnuts and bambara nuts. A few livestock are reared, these include goats, pigs, poultry and cattle. The major cropping patterns are; interplanting early beans with maize, planting millet as a relay crop to early beans, planting chilli peppers as a relay crop to early beans and intercropping sorghum with groundnuts.

There is a sub-urban market in Kasuwan Magani. It is the biggest market in the local government area and it shares a common boundary with Dutsen Gaiya to the south. The bulk of farm inputs are usually obtained in Kasuwan Magani which has every Thursday of the week

as its market day. The farm inputs sold here include fertilizers, seeds, pesticides and locally fabricated farm tools.

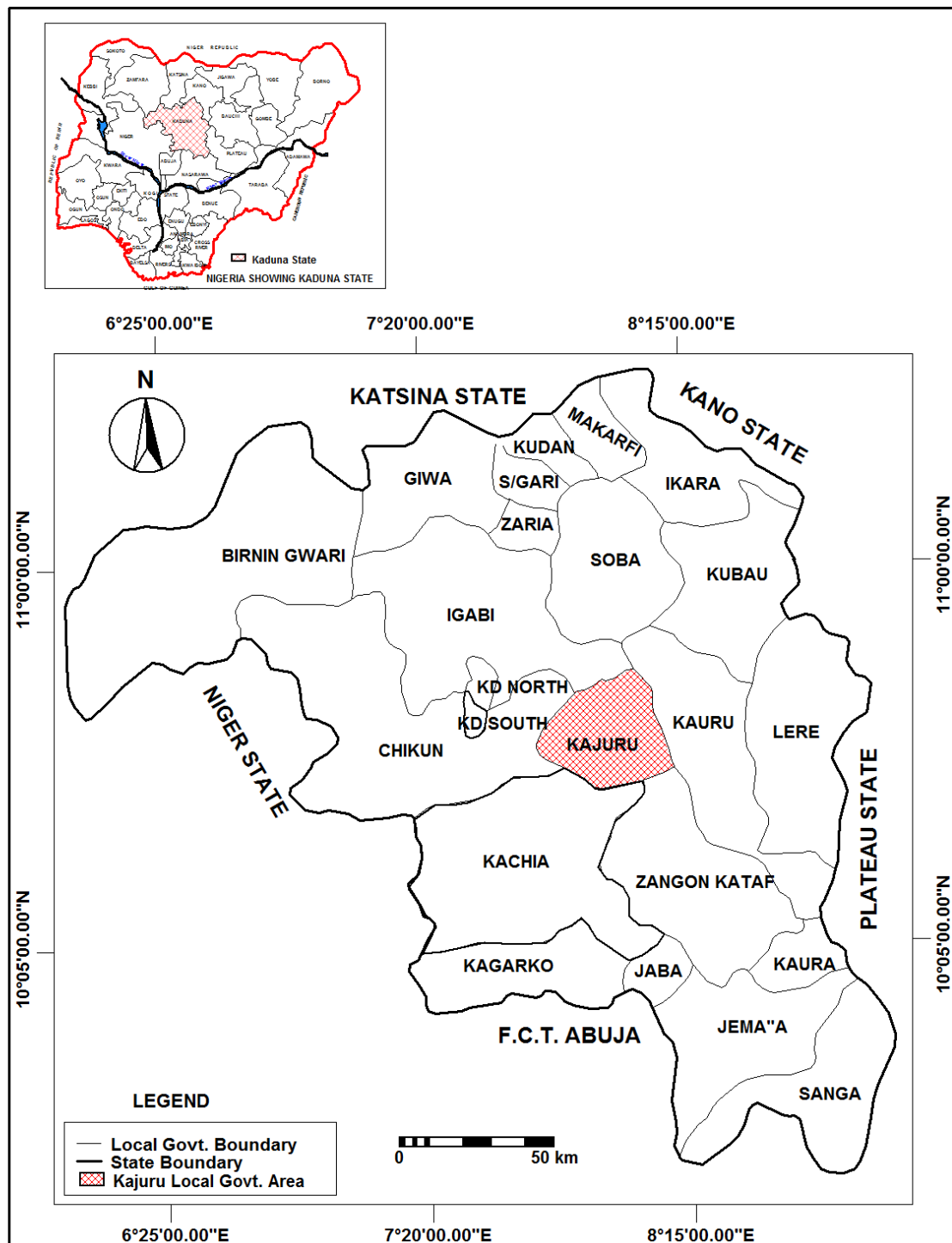


Fig. 1: Kaduna State Showing Kajuru Local Govt. Area

Source: Adapted and modified from Administrative map of Kaduna State

3.2 Sampling Procedure and Sample Size

The study was conducted in three communities namely: Kasuwan Magani, Dutsen Gaiya and Kufana. The three communities chosen for the study are considered to be producers of striga resistant maize and have had intensive on -farm trials of *striga* resistant maize production technologies conducted among a large number of “lead” farmers at the inception in 2003 (Franke *et al.*, 2006., Jolly,2008). From the list of adopters which was obtained during the reconnaissance survey collated from the above mentioned communities with the assistant of the village extension workers, 40 in Kasuwan Magani, 59 in Kufana and 21 in Dutsen Gaiya. These adopters constituted 10% of household maize farmers in each community which were selected as respondents. This gave a total of 120 respondents for the adopters. In the same communities, the same sample size of non- adopters was randomly selected to serve as a control group to give a total of 240 respondents. Well structured questionnaires were administered to both the adopters and non- adopters of *striga* resistant maize production technologies in Kajuru Local Government Area (LGA). In this study, adopters were those who participated in the programme and adopted the *striga* resistant maize technologies, while non-adopters were those who did not adopt the technologies.

3.3 Sources of Data Collection

Both primary and secondary sources of information were used. The primary data were obtained directly from adopters and non-adopters farmers in the study area. The primary data were collected by administering questionnaire to the respondents by trained enumerators. The data collected were on improved *striga* resistant maize production technologies recommended practices such as, good land preparation, seed dressing, time of planting, seed

rate, plant spacing, rate of inorganic fertilizer, organic manure and maize output, farm income and standard of living of the farmers.

The data were collected from both the adopters and non-adopters on the basis of the “with” and “without” adoption of the technologies, to ascertain its effects on maize output, farm income and farmers standard of living in the area. The secondary sources included journals, proceedings, textbooks, reports of the Kaduna State Agricultural Development Project (KADP), etc.

3.4 Analytical Techniques

Descriptive statistics such as, percentages, frequency distributions and mean have been used to achieve objectives i,ii,iii,iv, and vii of this study. Chow test was used to achieve objective v, i.e. the effects of the technologies on the adopters. The Chow test model was used to specifically assess hypotheses i,ii and iii on the effects of adoption of the technologies on the output, income and standard of living of the sampled population of this study. According to Dougherty (2000), chow test statistics is often used in programme evaluation to determine whether the programme has effect on different sub-groups of the population. Variables used were maize output, income and value of materials owned before and after the adoption of adopters and non- adopters. The Chow test is an application of the F-distribution test; it requires the sum of squared errors from two regressions, one from each sample group and one for the pooled data. If F-chow is greater than the F- table, then there was project impact on the adopters otherwise no impact. The Chow regression models are explicitly specified as follows:

$$Y = a_1 + b_1 * x_1 + c_1 * x_2 + u \text{ (adopters)}$$

$$Y = a_2 + b_2 * x_1 + c_2 * x_2 + u \text{ (non-adopters)}$$

$$Y = a + b \cdot x_1 + c \cdot x_2 + u \text{ (Both groups)}$$

$$a_1 = a_2, b_1 = b_2, \text{ and } c_1 = c_2$$

Hence,

$$Y = c(1) + c(2) \cdot X$$

Chow is represented by the formula:

$$Y = \frac{RSS - RSS_1 + RSS_2}{k}$$

$$RSS_1 + RSS_2 / n_1 + n_2 - 2k$$

Where:

RSS = Residual sum of square for pooled sample.

RSS_1 = Residual sum of square for adopters.

RSS_2 = Residual sum of square for non- adopters.

n_1, n_2 = Total number of observations.

K = Number of parameters

Multiple regression analysis was employed to achieve objective vi of the study, i.e. to identify the factors influencing adoption of *striga* resistant maize technologies; was also used to test hypothesis iv. The Multiple regression technique is used to estimate the contributions of each independent variable to the dependent variables.

The multiple regression models for this study were specified as follows:

$$Y = a_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 a_6 + \dots + b_{11} x_{11} + U$$

Where: Y = the number of recommended practices adopted by the respondents.

X_1	Age (year)
X_2	Family sizes (number of people in the household)
X_3	Educational (no. of years schooling)
X_4	Farm size (hectares)
X_5	Marital status (married = 1, other =0)
X_6	Contact by extension (number in 2010)
X_7	Amount of credit received (amount in naira obtained)
X_8	Membership of social organizations (yes/no)
X_9	Cropping systems (monocropping =1, mixed cropping = 0)
X_{10}	Use of labour (Man hour)
X_{11}	Amount of money spent on maize production (Naira per month)
U	= Error term
a_0	= Intercept
b_1 - b_{11}	= Regression co-efficients

3.5 Operationalization and Measurement of Variables

The variables for analysis in this study were age, family size, education, farm size, marital status, contact by extension, amount of credit received, cropping systems, use of labour, membership of socio-organizations, and amount of money spent on maize production.

3.5.1 Independent Variables and their Measurement

Age: This is the number of years an individual has spent from birth to the time of study. It was measured in years as stated by the farmer at the time of survey. Youthfulness has been reported to be associated with adoption of innovation (Atala, 1980).

Education: This referred to the capacity of an individual to acquire western knowledge and able to read and write. It was measured on a scale scored from 0-4, the farmer is scored thus: 0-No formal education, 1-Adult education, 2-primary education, 3-secondary education and 4-Tertiary education. Chianu and Tsuji (2004) reported that the higher the level of education the better the chance to adopt innovation

Family size: This is the total number of people in one household and eats in the same pots. This was measured by asking the head of the household. Dvorak (1996) reported that labour demanding technologies will be easily adopted in a large family.

Farm size: Farm size referred to the total number of hectares of farm land cultivated in the previous year. Farmers with large farm sizes have been reported to adopt agricultural innovations (Feder *et al.*, 1985).

Contact by Extension Agents: This referred to the frequency of contact of farmers with extension workers. It was measured by the total number of times a farmer is visited in connection with *striga* resistant maize varieties production. Farmers contact with agricultural extension agents has been reported to improve adoption of technologies (Smith *et al.*, 1994).

Membership of Social Organizations: This referred to the association of respondents in social group activities in social system. It was measured by their response to either belonging or not to a cooperative societies/community organizations.

Use of Labour: This referred to the workforce available to farmers. It was measured in man hour i.e the number of hours used by individual labour. Akanya (1990) confirmed in his studies that hired Labour was significantly related to adoption of horticultural innovations.

Cropping Systems: This referred to the number of crop mixed grown with maize by the farmers. This will be measured thus: Monocropping =1, mixed cropping =0.

Amount of Credit Received: Credit referred to the amount of institutional and non-institutional credit obtained in cash for the purpose of adopting *striga* resistant maize varieties. It will be measured by the total amount of money borrowed in naira. Credit supports have been shown to influence adoption (Ahmed *et al.*, 2002).

Marital status: This referred to whether the farmer was single or married as at the time of the study. This was measured thus: Married=1, single= 0. The unmarried has been reported to be more likely to be dependent on hired labour and communal cooperative work (Jolly, 2008)

Amount of Money spent on Maize Production: This referred to money spent on farm inputs such as seedlings, fertilizers, herbicides, pesticides. This was measured by asking farmer the amount spent on each and compute them to get the total amount in naira.

3.5.2 Dependent Variables

The dependent variable was adoption of recommended *striga* resistant maize production technologies along with the practices. This was measured by the farmers' yes or no response.

Adoption: adoption in this study was the acceptance and continuous use of recommended practices of *striga* resistant maize production by farmers such as:

Ridging

Ridges are made 75cm-90cm Intra row.

Planting:

Striga resistant maize seeds must be planted as soon as rains are established, but optimum sowing dates are 15th may- 30th June in the state.

Seed Rate:

- i. 17kg-20kg Hand planting for 1 plant per hole.
- ii. 34kg-40kg Hand panting for 2 plants per hole .

Spacing:

Between rows: 75cm- 90cm.

Between plants: 20cm-25 cm for 1 plant per stand and 30cm – 40cm for 2 plants per stand

This will give a plant population of about 53000 plants per hectare.

Seed Treatment:

Dress seed with Apron plus at one sachet to 2kg of seeds or Apron star at I sachet/4kg of seeds.

Fertilizer Application:

- i. Apply 120-150 kg of Nitrogen, 60kg of Phosphorus and 60kg of potassium per hectare.
- ii. Apply half of Nitrogen and all of the phosphorus and potassium at planting.
- iii. The second (2nd) half of Nitrogen is applied 4-5 weeks after planting, i.e. 8 bags of 20:10:10 NPK at planting and 2 bags of urea applied 4-5 weeks after (later).

Weeding:

Control weeds manually or with chemicals early.

i. For hand weeding, weed at 2-3 weeks after sowing and second weeding is done at 6 weeks after planting.

ii. For chemicals control:

(a) Use Primextra 500FW at 5 litres/ha pre-emergence.

(b) Use Primagram 500Fw at 5 litres/ha pre –emergence.

(c) Babamaize 550FW at 5 litres/ ha pre –emergence.

(d) Stamp 500EC at 4 litres/ha pre –emergence.

All pe-emergence herbicides should be applied not later than 2 days after planting.

Pest and Disease Control:

The major pests are stem borers, termites and birds.

i. For stem borers use furadan either as seed treatment or as post planting application at 3kg/ha or spray with vetox 85 at 50m/s in 10 litres of water using a knapsack sprayer.

ii. Termites: Apply dieldrin or aldrex T.

iii Birds: Use birds scarers

Harvesting:

Remove cobs from stalk and sundry before threshing. If this operation is to be delayed, cut stalks with cobs and stock in small upright bunches until a convenient time.

Storage:

Store the dry grains in clean granaries and /or containers like drums, jute bags and plastic containers. To prevent infestation, use:

- i. Actellic 2% dust at 0.5kg/t of grains.
- ii. Actellic 25 Ec at 50 m/s in 10 liters of water and spray with knapsack sprayer.
- iii. Use photoxin at one tablet per bag (of 100kg) of grains in air light conditions.

3.5.3 Effects

Maize output: This variable was measured as total output of maize in 100kg/bags accruing to the farmer during the 2010 cropping season.

Maize yield: This variable was measured as the total output of maize in 100kg/ bags accruing to the farmer during 2010 cropping season divided by the total hectarage put into production.

Income: In this study farm income referred to the total money in naira that accrues to the *striga* resistant maize farmer as a result of sales of maize in the period under review (2010). It was computed by using the price in naira per 100kg bag of maize and multiplied by the total number of bags produced by the maize farmer.

Standard of living: This was the level of material comfort as measured by the goods, services, and luxuries available to *striga* resistant maize farmer. For this study, standard of living was measured by ownership and usage of material things such as bicycles, kerosene stove, lantern, motor cycle, personal house, mattresses, etc. This was converted into monetary value.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio- economic Characteristics of Adopters and Non-adopters of *Striga* Resistant Maize Technologies

In this section detail of the general socio – economic characteristics of adopters and non-adopters of *striga* resistant maize production technology is provided. These include age, size, extension contacts, and membership of social organization, use of labour, farm enterprise, credit and amount spent as shown in Table 4.1.

4.1.1 Age distribution

As shown in Table 4.1, 62% of the adopters were between the ages of 46-55 years, those between ages 56 years and above were 5%. Also, the findings reveal that 8% of the farmers were within the ages of 25 – 35 years while ages between 36 – 45 years constituted 25%. For non-adopters, 46-55 years of age were 58%, 36-45 years old were 27%, 25 -35 years old were 6%, while 56 years old and above represented 9% of non-adopters. A mean age of 48 was however, obtained for adopters of *striga* resistant maize production technologies with standard deviation of 7 implying that farmers at this age bracket could have better perception of new technologies introduced to them. This finding agrees with Akpoko (2004) who posits that young people are more receptive to modern ideas than older ones.

4.1.2 Educational status of the Respondents

Results in Table 4.1 reveal that 6% of the adopters attended Quranic schools, 15% had adult education, and 38% had primary education, secondary education constituted 35%, while the

highest educational level was Nigeria Certificate in Education (NCE)/Diploma which constituted 7% of the adopters. The non-adopters had majority 41% acquired primary school education, secondary education was 32%, adult education was 13%, Quranic education was 11%, while 4% represented non-adopters that acquired tertiary education.

Generally, 95% of adopters of *striga* resistant maize production technologies had formal education which implies that farmers' diversity of knowledge had an influence on adoption of the technology. This finding supported Nweke (1981) whose report revealed that an educated farmer is less skeptical of a new idea and is more able to evaluate information on improved practices.

4.1.3 Marital status

Table 4.1 also shows that 3% of adopters were singles, while 98% were married. Non-adopters had 92% who were married and 8% represented the singles. In the case of adopters, this implies that their women would work alongside their farming husbands in any adopted technologies that involve planting, harvesting and processing of grains as reported by Ekong (2003). In Africa where farming is subsistence in nature farmers depend largely on family labour.

4.1.4 Family size

Findings in Table 4.1 reveal that 43% of adopters had 6-10 family size, 23% of the adopters had 0 – 5 family size, while 25% had 11 – 20 household size, and the least 9% of the adopters had 21 and above household size. Non-adopters largest household, 21 families size and above was

7%, 11- 20 family size was 27%, 38% constituted 6-10 family size, while the least 29% of non-adopters had 0-5 family size.

In terms of family assistance on the farm, 96% of adopters of *striga* resistant maize technologies said that they used family labour. On the average, the mean family size used was 11 with standard deviation of 9. This implies that more hands were available to carryout necessary practices introduced to adopters of *striga* resistant maize production technologies. This finding agrees with Chianu and Tsuji (2004) that reported that large family sizes are more likely to adopt some soil improvement technology due to sufficient labour.

4.1.5 Farm size

Results in Table 4.1 shows that 65% of adopters had farmland less than 1 hectare, 25% had farmlands less than 2 hectares, while 10% possessed farm land greater than 3 hectares. In the case of non-adopters, 4% of the respondents had farm size greater than 3 hectares. Majority (67%) had farm size less than 1 hectare, while 29% represented those that had farm size less than 2 hectares.

On the average, the mean farm size used by adopters of *striga* resistant maize production technologies was 1.2 hectares with a standard deviation of 0.76. This classification implies that farmers in the study area were small scale farmers who need to be encouraged to embark on large scale farming. This finding supported Ojukaiye (2001) that reported that this would not allow for meaningful investment and returns to scale on food security.

4.1.6 Extension contacts

Results in Table 4.1 shows that 45% of the adopters had 6 – 9 extension, 35% had less than 5 extension contacts while 20% had more than 10 extension contacts. For non-adopters, 56% claimed they had less than 5 extension contacts, 42% had 6-9 extension contacts while 3% had more than 10 extension contacts. On the average, the mean extension contacts had by adopters of *striga* resistant maize production technologies were 7 extension contacts with a standard deviation of 3. This classification implies that farmers in the study area were visited by extension agents which utmost led to the adoption of *striga* resistant maize production technologies by the farmers. This finding agrees with Drorak (1996) whose report proved that contact with extension agents enables farmers to obtain information on improved agricultural technology.

4.1.7 Membership of Social Organizations

Findings in Table 4.1 show that 77% of non-adopters belong to social organizations; while 23% did not join any social organizations. Adopters of *striga* resistant maize production technologies had 70% of them as members of social organizations, while 30% did not belong to any social organizations. Out of those that were members of social organizations, 69% had spent 6 – 10 years as members, while 31% had been members for less than 5 years.

Furthermore, 72% of adopters of *striga* resistant maize production technologies claimed they benefited the following as members; purchase of fertilizers, pesticides and maize seedlings. 30% however, said that they never benefited as members of their social organizations. Generally, on the average, the mean numbers of years spent as members of social organizations was 2 years with a standard deviation of 4. This classification implies that being a member of an association in the study area led to adoption of the *striga* resistant maize

technologies. This agrees with Atala (1998) whose finding revealed that farmers' membership of associations provided both information and credit and encouraged adoption of recommended practices.

4.1.8 Use of Labour

The study in Table 4.1 also reveals that 96% adopters used family labour and 85% of non-adopters used family labour. Also 4% of adopters used family and hired labour; while 15% of non –adopter used family and hired labour. On the average the mean labour used on the farm lands was 4 with a standard deviation of 3. Also, on the average the mean man hour spent on the farmlands was 8 hours. This classification implies that majority of the respondents are subsistence farmers, married, who depended on their households as source of labour. This agrees with Jolly (2008), who reported that in Africa where farming is mainly dependent on family labour, the unmarried often lack the necessary farm help operations especially in gender performed tasks.

4.1.9 Cropping systems

Result in Table 4.1 shows that 90% of non-adopters carried out mixed cropping while 10% mono-cropping of maize only. However, 85% of adopters of *striga* resistant maize production technologies cultivated one or two of the following crops along with *striga* resistant maize; soya bean, cowpea, rice, millet and sorghum, while 15% said they cultivated only *striga* resistant maize.

Further findings reveal that 63% of the adopters had full farming as their major occupation, 8% were civil servants who engaged in farming while 30% are into farming and trading. This classification implies that majority were mixed cropping farmers who also, engaged in other occupations, hence they have other source of income to be able to adopt technology that involve financial implication and reduces, problem of food security and unemployment. This agrees with Unama (1991) who reported that these are very important to the economy for food security, poverty alleviation and economic likelihood for many households.

4.1.10 Credit

As shown in Table 4.1 both adopters and non-adopters didn't have access to credit from financial institutions or government. All of them however sourced their funds personally. On the average, the mean personal credit raised by adopters of *striga* resistant maize production technologies was N105, 550.00 with a standard deviation of N93,370.00. This classification implies that adopters of *striga* resistant maize production technologies in the study area could have raised their money through monthly salary or trading in goods and services. Credit is essential in purchasing farm inputs that are required for the adoption of recommended practices. This agrees with Ekong (2003) whose report revealed that credit is a very strong important factor that is needed to acquire or develop farm enterprise. Its availability could determine the extent of production capacity.

4.1.11 Amount spent on *Striga* Resistant Maize Production

Table 4.1 shows that 5% adopters of *striga* resistant maize production technologies spent more than N1,000 per month, 85% spent between N1, 000 – N5, 000 per month, while N6, 000

and above; constituting 10% of the adopters; was spent on their farmlands per months. On the average, the mean amount spent by adopters of *striga* resistant maize production technologies was ₦2617.50 with a standard deviation of ₦2362. This classification implies that money was spent to achieve good production by adopters of *striga* resistant maize production technologies. This agrees with Jolly (2008) findings that farmers with fairly good income will be more likely to take risks in adopting innovation, hence are more of innovators and early adopters while those with low income tend to be risk avoiders.

Table 4.1: Socio-economic Characteristics of Adopters and Non-adopters of *Striga* Resistant Maize

Farmers						
Adopters			Non-adopters			
Characteristics	Frequency		Frequency		Percentage (%)	
Percentage (%)						
Age	Mean				Mean	
25-35	9	7.5	48	7	5.8	50
36-45	30	25		32	26.7	
46-55	75	62.5		70	58.3	
56- above	6	5		10	9.2	
Education						
Quranic	7	5.8	5	13	10.8	5
Adult Education	18	15		15	12.5	
Primary Education	45	37.5		49	40.8	
Secondary Education	42	37.0		38	31.7	
Tertiary Education	8	7		5	4.2	
Marital status						
Single	3	2.5	1	10	8.3	1
Married	117	97.5		110	91.7	
Family size						
0 – 5	27	22.5	11	35	29.2	12

6 – 10	52	43.3		45	37.5	
11 – 20	30	25		32	26.7	
21 – above	11	9.2		8	6.6	
Farm size						
< 1 hectares	7 8	65	1.2	80	66.7	2.9
<2 hectares	30	40		35	29.2	
> 3 hectares	12	10		5	4.1	
Extension contacts						
< 5 contact	42	35	7	67	55.8	6
6- 9 contact	48	45		50	41.7	
>10`	24	20		3	2.5	
Social organizations						
Yes	84	70	2	92	76.7	6
No	36	30		28	23.3	
Use of labour						
Family labour	115	96	4	102	85	11
Family and hired labour	5	4		18	15	
Credit received						
Banks	0	0	105,550	0	0	166,308
Personal	120	100		120	100	
Cropping systems						
Mono-cropping (Maize)	18	15	0.15	12	10	0.05
Mixed-cropping	102	85		108	90	
Amount spent on striga resistant maize						
>N1, 000	6	5	2617.50			
N1, 000 – N 5,000	102	85				
< N6,000	12	10				
	120	100		120	100	

4.2 Level of Adoption of *Striga* Resistant Maize Recommended Practices in the Study Area

Findings in Figure II show that a large number of the adopters (92%) adopted ridging. This is in line with Antwi and Asiamah (1993) who reported that ridging is a common practice in the Northern Guinea Savannah where this study was conducted. Seed rate had 83% level of adoption. Planting correctly was reported by 96% of the adopters, while spacing and seed treatment had 67% and 92% level of adoption respectively.

Fertilizer application had the highest 98%, level of adoption. This can be seen as evident in the yields of the respondents. This agrees with Akpoko (2004) whose report showed that proper application of fertilizer has been described as an essential prerequisite for the realization of increase crop yield as well as for restoration and maintenance of soil fertility. Weeding and storage recorded 46% and 58% level of adoption respectively. These could be attributed to less *striga* effect experienced in the maize farmlands. Also, maize is one of the staple foods consumed daily it's quickly marketed, hence not required storage by most of the subsistence farmers. Pests and disease control had high level of adoption 92%, while harvesting had 83% level of adoption.

Generally, there was high level of adoption of *striga* resistant maize production technologies introduced to the farmers as shown in figure 4.3. This high level of adoption supported Rauniyar and Goode (1996) whose report showed that farmers tend to adopt packages rather than individuals technology component or practices.

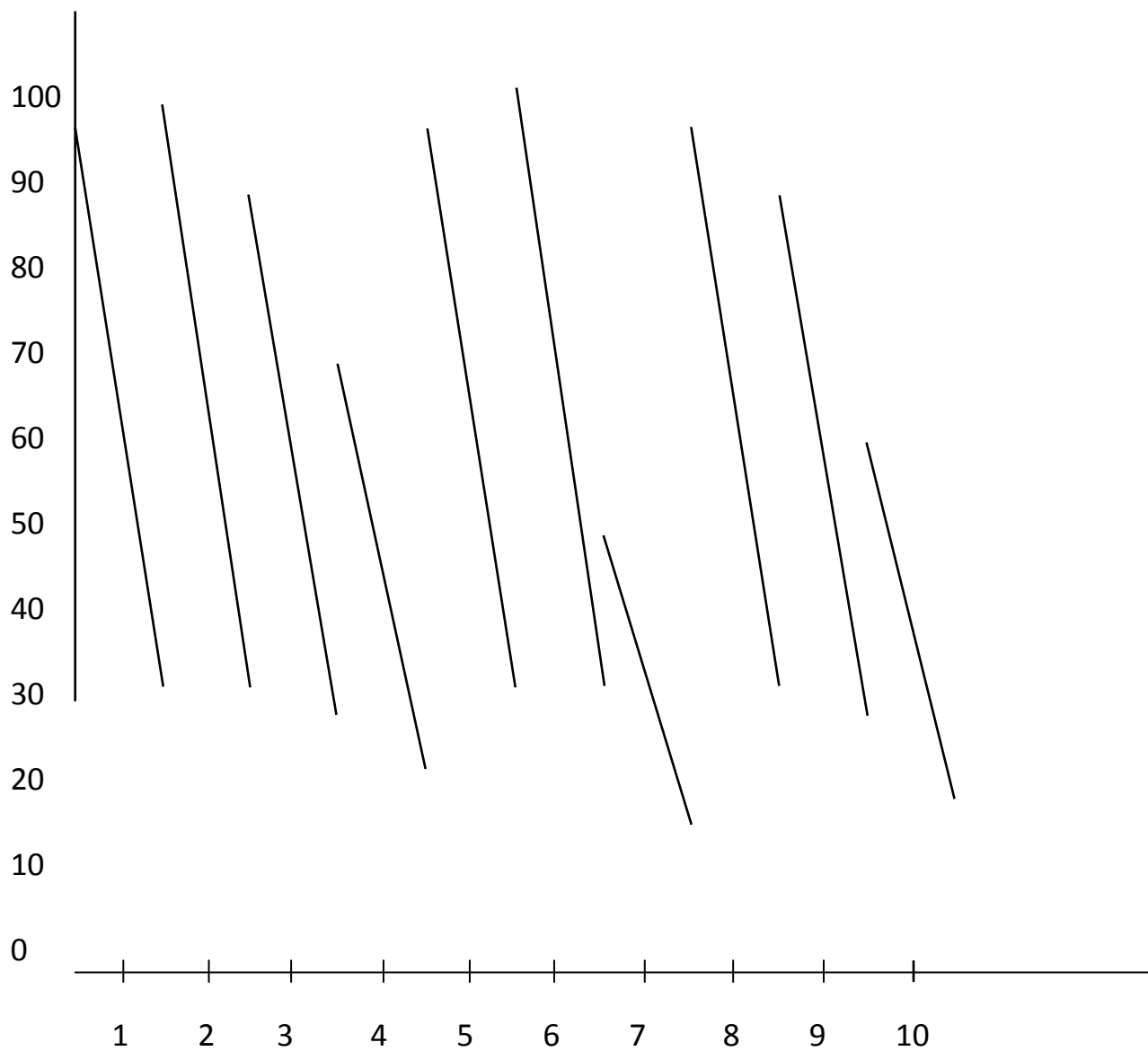


Figure 4.3: Level of Adoption of *Striga* Resistant Maize Production Technologies

Legend

1. Ridging (92%)

6.Fertilizer application (98%)

- | | |
|-------------------------|-----------------------------------|
| 2. Planting (96%) | 7. Weeding (46%) |
| 3. Seed rate (83%) | 8. Pest and disease control (92%) |
| 4. Spacing (67%) | 9. Harvesting (83%) |
| 5. Seed treatment (92%) | 10. Storage (58%) |

4.3 Sources of Information on *Striga* Resistant Maize Production Technologies

The finding in Figure 4.3 shows that 65% of the adopters got in contact with *striga* resistant maize production technologies through the KADP extension agents, 20% of them said that it was through KADP, extension agents, and other sources such as IITA, KADP extension agents and friends was 8%, while 5% reported that it was through KADP extension agents and radio, 3% said it was through their friends. The use of several sources of information agrees with Babaleye *et al.* (2002) and Frank *et al.* (2006) who had earlier reported that the *striga* resistant maize seeds were introduced to farmers in the study area by several agencies.

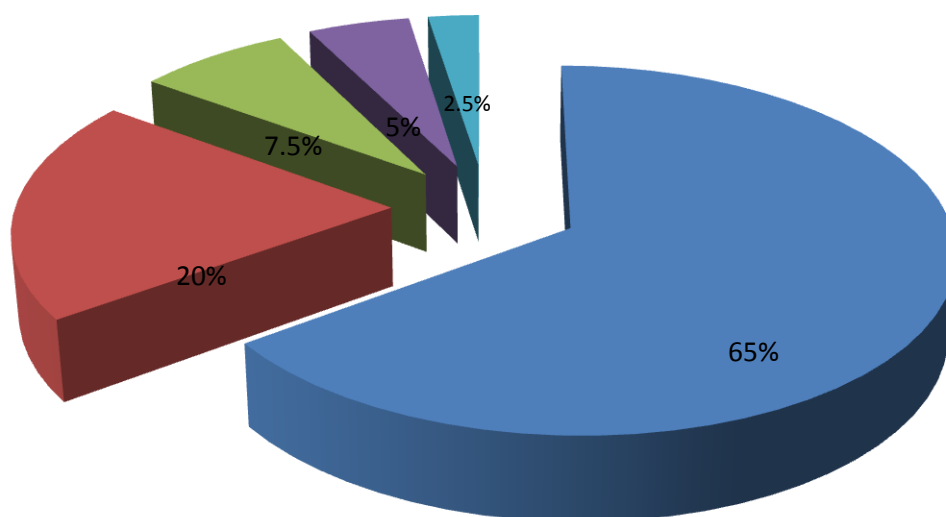


Figure 4.4: Sources of Information on *Striga* Resistant Maize Production

Technologies

Legend

1. KADP extension agents (65 %)
2. KADP extension agent and IITA (20%)
3. KADP extension agents and friends (7.5%)
4. KADP extension agents and Radio (5 %)
5. Friends (2.5%)

4.4 Soil Management Practices Adopted along with *Striga* Resistant Maize Production Technologies

Soil management practiced in the study area along with adoption of *striga* resistant maize production technologies as shown in Figure 4.5 revealed that, 76% of the adopters

adopted crop rotation and bush fallowing, 20% adopted crop rotation, bush fallowing with addition of farm yard manure (FYM), while application of green manuring and mulching; constituted 4% of the adopters; who adopted these practices. This implies that the adopters in the study area also practiced various types of soil management practices to enhance their production. This agrees with Pretty (1995) whose findings revealed that it is a practice that rarely has ecological or economic drawbacks and many farmers regard it as an essential component of prudent management.

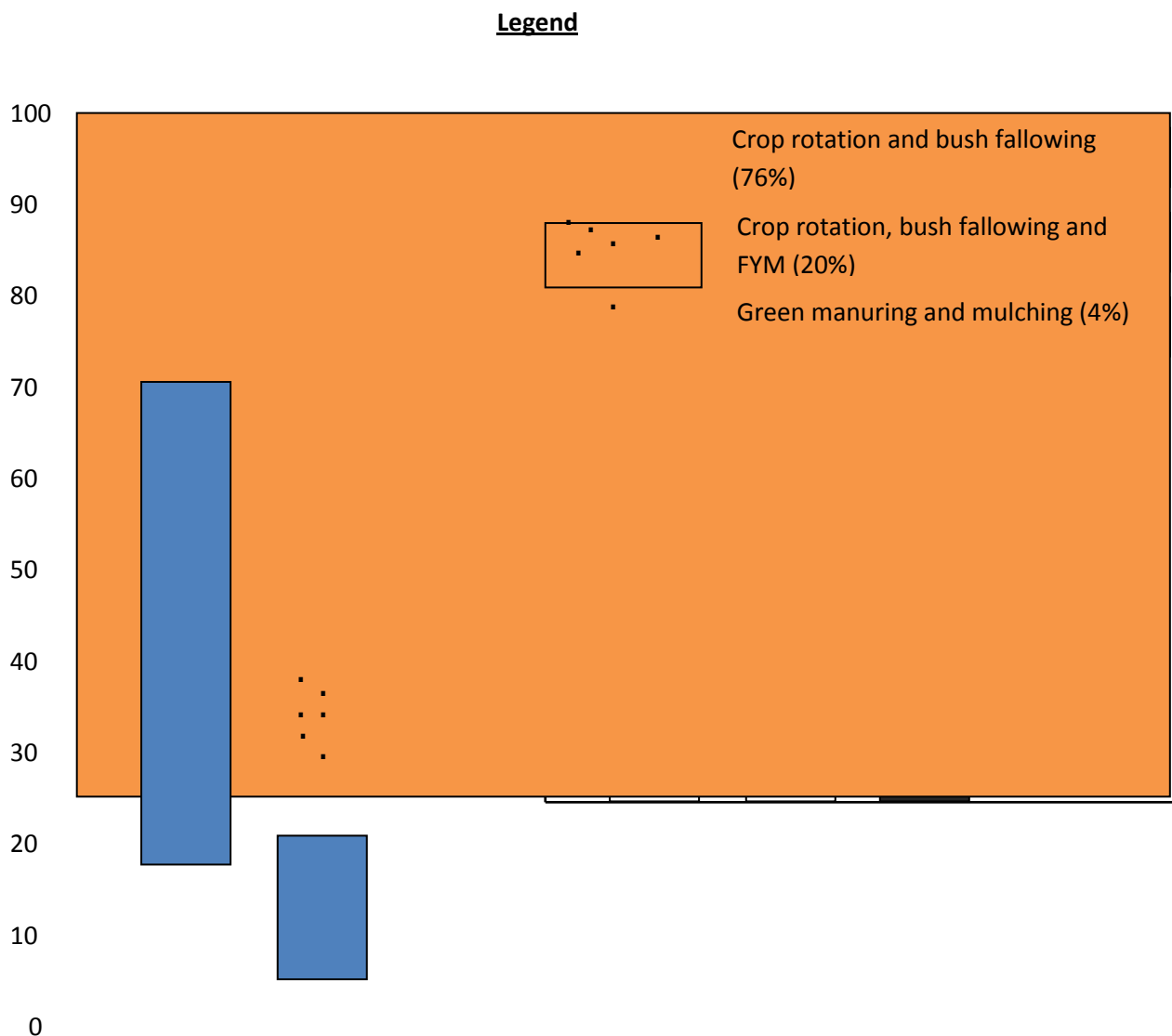


Figure 4.5: Soil Management Practices Adopted along with *Striga* Resistant Maize

Production Technologies

4.5 Effects of Adoption of *Striga* Resistant Maize Production Technologies

In this section detail of the effects of adoption of *striga* resistant maize production technologies on adopters maize output, income and standard of living are provided.

4.5.1 Effects of Adoption of *Striga* Resistant Maize Production Technologies on Adopters Maize Output/yield

In the study area, the total farm area under cultivation of *striga* resistant maize was 61.5 hectares for adopters; with maize output of 305,347.5kg after adoption from an initial maize output of 219,927kg before adoption, this gave a total increase of 39% (85,420.5kg) maize output after adoption. Also 37.7 hectares were cultivated by non-adopters with maize output of 114,796kg from initial average maize output of 110,986 kg. In respect of crop yields on the average the total maize yield in the study area for adopters was 4,965kg/hectare and 3,045kg/hectare for non-adopters. Further analyses using chow – test to determine the impact of *striga* resistant maize production technologies is as shown in Table 4.2.

Table 4.2 Effects of Adoption of *Striga* Resistant Maize Production Technologies on

Adopters Maize Output

Group/Model	Regression	Residual sum of	$n_1 + n_2$	K	F- Cal	F –table
$Y = c(1) + c(2)*X$	coefficient	square				

Pooled sample	0.91490	51.288	240	3	25.65	8.53
Adopters	0.48056	63.120				
Non - adopters	0.4.0120	13.288				

F- Cal (25.65) > F –Tab (8.53)

Analyses show that R^2 adjusted value of 0.48 implies that 48% of the variations in the adoption of *striga* resistant maize production technologies contributed to change in maize outputs of adopters; hence the *striga* resistant maize production technologies had effect on adopters in terms of their output after adoption. Adopters gave advantages of adopting *striga* resistant maize production technologies to include early germination by 83% of the adopters, 69% claimed that it gave high yields, while 59% of the respondents said that it reduced the effects of *striga*.

Hypothesis i

The null hypothesis tested in this research states there is no significant difference in the maize outputs between adopters and non- adopters of *striga* resistant maize production technologies in the study area. The decision rule states that if F-calculated is greater than the F- tabulated, then there was project impact on the adopters otherwise no impact. Using a degree of freedom (P=0.05), the result in Table 4.3 reveals that F-calculated (25.65) is greater than the F-tabulated (8.53). The null hypothesis is hereby rejected while the alternative is accepted. The conclusion here is that there is significant difference in the maize outputs between adopters and non-adopters of *striga* resistant maize production technologies in the study area in favour of the adopters.

4.5.2 Effects of Adoption of *Striga* Resistant Maize Production Technologies on Adopters Income

In the study area, a total of 3,054 bags/100kg of *striga* resistant maize production technologies were produced in the year under review. With market value of maize at N4000/bag, the total income realized by adopters was N12, 216,000.00 from initial income of N8, 706,000.00 before adoption, while income for non-adopters was N4, 591.880.00 from initial income of N4,439,440. Further analyses using *chow* – test to determine the effect of adoption of *striga* resistant maize technologies on adopters' income is as shown in Table 4.3.

Table 4.3: Effects of Adoption of *Striga* Resistant Maize Production Technologies on Adopters Income

Group/Model $Y = c(1) + c(2)*X$	Regression coefficient	Residual sum of square	$n_1 + n_2$	K	F- Cal	F – Table
Pooled sample	0.89578	67.345	240	3	38.26	8.53
Adopters	0.46136	77.245				
Non – adopters	0.13829	54.840				

F -cal (38.26) > F-tab(8.53)

Analyses show that R^2 adjusted value of 0.46% implies that 46% of the variations in the adoption of *striga* resistant maize production technologies contributed to change in farm incomes of adopters. This could be attributed to increase in maize outputs which had a corresponding increase in income of the participating farmers.

Hypothesis ii

The null hypothesis tested in this research states that there is no significant difference in income between adopters and non-adopters of *striga* resistant maize production technologies in the study area. The decision rule states that if F-calculated is greater than the F- tabulated, then there was project impact on the adopters otherwise no impact. Using a degree of freedom (P=0.05), the result in Table 4.3 reveals that F-calculated (38.26) is greater than the F-tabulated (8.53). The null hypothesis is hereby rejected while the alternative is accepted. The conclusion here is that There is significant difference in income between adopters and non- adopters of *striga* resistant maize production technologies in the study area in favour of the adopters.

4.5.3 Effects of Adoption of *Striga* Resistant Maize Production Technologies on Adopters Standard of Living

Findings show that both the adopters and non-adopters of *striga* resistant maize production technologies used their proceeds from the sale of maize to improve their standard of living such as building of zinc houses, purchase of motor cycles, purchase of lands etc. The total average money spent by adopters to improve their standard of living was ~~₦~~8,998,627; ~~₦~~3,678,589 before adoption while that of non-adopters was ~~₦~~3,757,406 and ~~₦~~3,64,5890 before the introduction of *striga* resistant maize technologies. This shows that there was no appreciable difference in the spending of non-adopters as compared to the adopters. Further analyses using chow – test to determine the effects of adoption of *striga* resistant maize production technologies on adopters’ standard of living in terms of acquired properties, is as shown in Table 4.4.

Table 4.4: Effects of Adoption of *Striga* Resistant Maize Production Technologies on Adopters’ Standard of Living

Group/Model Y= c(1) + c(2)*X	Regression coefficient	Residual sum of square	n ₁ + n ₂	K	F-Cal	F – Table
Pooled sample	0.7299	54.478	240	3	30.15	8.53
Adopters	0.6511	61.778				
Non – adopters	0.5849	27.004				

F -cal (30.15) > F-tab (8.53)

Analyses show that R^2 adjusted value of 0.65% implies that 65% of the variations in the adoption of *striga* resistant maize production technologies contributed to change in standard of living of adopters. This agrees with Hassan (2006), whose findings revealed that adoption of *striga* resistant maize production technologies improves the living standards of farmers in savannah zones.

Hypothesis iii

The null hypothesis tested in this research states that There is no significant difference in standard of living between adopters and non- adopters of *striga* resistant maize production technologies in the study area. The decision rule states that if F-calculated is greater than the F- tabulated, then there was project impact on the adopters otherwise no impact. Using a degree of freedom (P=0.05), the result in Table 4.5 reveals that F-calculated (38.26) is greater than the F-tabulated (8.53). The null hypothesis is hereby rejected while the alternative is accepted. The conclusion here is that there is significant difference in standard of living between adopters and non- adopters of *striga* resistant maize production technologies in the study area in favour of the adopters.

4.6 Factors Influencing Adoption of *Striga* Resistant Maize Production Technologies Adopters

The regression analysis (Table 4.5) shows that the coefficient of multiple determinations R^2 adjusted value is 0.513, while the remaining 0.487 is as a result of not including some other important explanatory variables as well as errors in estimation. The variables such as age (X_1), marital status (X_5), extension contact (X_6), social organization (X_8) and use of labour (X_{10}) were statistically significant at explaining the factors influencing adoption of *striga* resistant varieties. Age and marital status had estimated T- value of .7571 and 4.327, respectively which were positive and statistically significant at 1%. In other words, as age and marital status increases, intensity of adoption of *striga* resistant maize production technologies increases. Age plays an important role in agriculture as well as influences the adoption of improved technologies as reported by Petal *et al.* (1971). Also, marital status especially marriage; encourage them to adopt technologies that involve gender tasks as concurred by Jolly (2008).

The T-value with respect to extension contact (X_6) was 3.00, social organization (X_8), 2.842 and use of labour (X_{10}), 2.750 were also positive and significant at 1% showing a direct influence on the adoption of *striga* resistant maize production technologies. Research findings showed that extension contact contributed to the dissemination of both information and *striga* resistant maize production technologies to the respondents as agreed to by Dvorak (1996). Social organization farmers belonged to in the study area gave information to their members as recorded in the research findings. Also, purchase of fertilizers and maize seedlings were some of their benefits of joining the organization, which was in line with the findings of Clark *et al.* (1968). Use of labour especially family labour influence adoption of *striga* resistant maize production technologies as more hands assisted the farmers on the farm resulting into more yields as revealed in the research findings which agrees with findings of Chianu and Tsuji (2004).

Hypothesis iv

Based on the findings of this study in Table 4.5, the hypothesis that Farmers' socio-economic and institutional factors have no significant effect on adoption of *striga* resistant maize production technologies in the study area was rejected because they influenced adoption in the study area. The results from the multiple regressions revealed that R^2 adjusted value of 0.513 implied 51.3% of the variables influenced the adoption of *striga* resistant maize production technologies. Variables like age, marital status, extension contact, social organization and use of labour influenced the adoption of the technologies and were significant at 1%. The alternative that Farmers' socio-economic and institutional factors have significant effect on adoption of *striga* resistant maize production technologies in the study area is accepted in favour of the adopters.

Table 4.5: Regression Analysis of Factors Influencing Adoption of *Striga* Resistant Maize Production Technologies

Variables	Regression coefficient	Standard error	T – value	Level of significance
Constant	9.248	.382	24.209	.000
Age (X ₁)	.053	.007	.7.571	.000 ***
Family size (X ₂)	7.968	.008	.996	.322
Education (X ₃)	.013	.040	.325	.717
Farm size (X ₄)	.114	.130	.877	.381
Marital Status (X ₅)	1.190	.275	4.327	.000 ***
Extension Contact (X ₆)	-.009	.003	-3.00	.005 ***
Credit (X ₇)	-8.541	.080	-1.068	.291
S. Organization (X ₈)	.036	.013	2.769	.005 ***
Cropping system (X ₉)	-.048	-.002	-.024	.981
Use of labour (X ₁₀)	.033	.012	2.750	.006 ***
Amount spent (X ₁₁)	-2.421	.026	-.093	.926

Adjusted R² = .513, Significant at 1%, ***

4.7 Constraints to Adoption of *Striga* Resistant Maize Production Technologies

Majority of the sampled adopters faced one problem or another though at different level of intensity, which has far reaching negative consequences on production. These problems are summarized below.

The data show that lack of money ranked first as a major constraints complained by 52% of adopters interviewed. This was followed by costly farm inputs which constituted 35% of the adopters. Cost of labour and transportation of maize had 27% and 27%, respectively, while lack of tractor constituted 18% of those interviewed. Lagoke *et al.* (1999) observed that adoption of *striga* tolerant hybrids may be limited among the small scale farmers by the high managements and cost of production.

Table 4.6: Constraints to Adoption of Striga Resistant Maize Production Technologies

According to their Level of Intensity.

Constraints	Number of Respondents	Percentage	Ranking
Lack of Money	62	51.5	1 st
Expensive farm inputs	42	34.7	2 nd
Cost of labour	33	27	3 rd
Transportation of maize	32	26.5	4 th
Lack of Tractor	22	18	5 th

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study was undertaken to determine the effects of *striga* resistant maize production technologies in Kajuru Local Government Area of Kaduna State. The data for this study were collected from primary sources. Data collections were done through the use of structured questionnaire instrument. Random sampling techniques were used to select 240 adopters and non-adopters from the local government area. These 240 respondents comprised 120 each for both adopters and non-adopters of *striga* resistant maize production technologies. A total of 95% of the *striga* resistant maize production technologies farmers were within the age bracket of 25 – 55 years, signifying that farmers involved in the technologies had an active force. This implies that the issue of food security is not a problem, due to large percentage of active force in the study area. As far as education is concerned, the study reveals that 94.2% of the *striga* resistant maize production technologies farmers had one form of formal education or the other. This shows that the rate of literacy is very high hence, increasing their perception and adoption of the technologies.

Marital status reveals that majority 98% were married with highest percentage of family size of bracket 6 – 10 family members constituting 43%. This implies that the *striga* resistant maize production technologies farmers had more mouth to feed which could have necessitated the adoption of the technologies which has high yield. The large family size was put to use on the farmlands, as findings shows that 96% of the adopters used family labour. Farm size, revealed that majority are subsistence farmers as 75% have within 1 – 3 hectares; farmers had adequate information on *striga* resistant maize production technologies as 45% of the farmers had

between 6 – 9 contact in a season. Majority 85% of the adopters cultivated one or two crops alongside the *striga* resistant maize. Also, majority 84% of the respondents were members of social organizations.

The regression analysis revealed that chow-F calculated was greater than F tabulated indicating that the *striga* resistant maize production technologies had positive effects in the lives of the adopters. The results from the multiple regressions revealed that R^2 adjusted value is 0.513, implying that 51.3% of the variations in the adoption of *striga* resistant maize production technologies is caused by the variables specified including age, marital status, extension contact, social organization and use of labour. The null hypotheses that there are no significant differences between maize outputs, incomes and standard of living of *striga* resistant maize production technologies adopters and non-adopters and that Farmers' socio-economic and institutional factors have no significant effect on adoption of *striga* resistant maize production technologies in the study area were rejected. Lack of money was a major constraint to the adoption of *striga* resistant maize production technologies.

5.2 Conclusion

This study revealed that the introduction of *striga* resistant maize production technologies has some effects on the farmers who adopted the technologies in the study area. The technologies increased maize output of the adopters by 38.8% more than that of non adopters, broaden their knowledge about *striga* prevention through advisory services, and increased their standard of living through the increased in their income; used to purchase material things.

5.3 Contributions to Knowledge

- i. There was high (81%) level of adoption of *striga* resistant maize technologies by farmers in the study area.
- ii. Variation of 62 % in the adoption of *striga* resistant maize production technologies was caused by adopters' age, marital status, extension contact, social organization and use of labour.
- iii. Maize outputs, income from maize production and standard of living of adopters increased by 39%,40% and144% respectively,showing a significant effects of adoption of *striga* resistant maize production technologies.

5.4 Recommendations

Based on the findings of the study, the following recommendations are proffered to encourage the usage of *striga* resistant maize production technologies in the study area:

- i. Findings revealed that full usage of all technologies practices was low. For full acceptance and continuous use of these recommended practices, extension agents should be motivated by both government and non-governmental organization to increase their contacts, and possibly use better medium of communicating to the farmers.
- ii. There were effects of adopted *striga* resistant maize technologies in terms of maize yield and total output; this was on a small scale due to their small farm holdings. Farmers' cooperative societies should encourage farmers to combine their farmlands for large scale maize farming, and also encourage mechanized

farming. This would further improve their living standards and ensures food security.

- iii. Age and extension contact were among factors influencing the adoption of *striga* resistant maize production technologies. Government and non-governmental organizations should come up with policy that would encourage youths to go into farming, and also extension agents should be motivated to improve their work in terms of more dissemination of information in the studied area.
- iv. Major constraints identified included low capital outlay and expensive farm-inputs. It is recommended that credit should be made available to *striga* resistant maize production technologies farmers through assistance of the government, private investors, donors and non-governmental organization.

5.5 Suggestions for Further Study

From the findings and conclusion of this study, the following suggestions for further study are made:

- i. There is need to conduct a comprehensive study on the rate of adoption of *striga* resistant maize production technologies from time to time to ascertain the acceptability and the spread of the technologies in Kajuru Local Government Area.
- ii. Assess the role of extension agents and methods used for teaching *striga* resistant maize production technologies to adopters in the study area.
- iii. There is need to extend this research to kachia that also had *striga* resistant maize technologies introduced there to know it's effects on the adopters.

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APPENDIX I: FARMERS QUESTIONNAIRE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, FACULTY OF AGRICULTURE, AHMADU BELLO UNIVERSITY, ZARIA.

Sir/Madam,

You Are Humbly Requested To Respond With All Honesty To This Questionnaire. All Information Provided By You Will Be Treated With Utmost Confidentiality.

SECTION A: BACKGROUND INFORMATION (ADOPTER AND NON-ADOPTER)

1.Name of Farmer-----2.Village-----3.District-----
-----4.Tick the category you belong to. Adopter [] Non-
adopter []

SECTION B: SOCIO –ECONOMIC CHARACTERISTICS AND INSTITUTIONAL FACTORS

5. Age of respondent ----- (years)

6. Sex of respondent (a) male [] (b) female []

7. Marital status (a) married [] (b) single []

8 (a).Farmer's household size :.....(number)

(b).Number of family members used on maize farm :----- (number)

9. Hired labour used on maize farm :----- (number)

10 (a). What is the size of your maize farm land?-----

(b). Methods of acquisition of your maize farm land:

(i) purchased [] (ii) leased [] (iii) inheritance [iv] rent [] (v) pledged []

(vi) loan [] (vii) gift [] (viii) govt. allocation [].

11. Western educational qualification

(a) Adult

education years (b) Primary education -----

years (c) Secondary education.....years (d) Tertiary education-----years
(e) other (specify):------years

12. Major occupation of the respondent (tick). (a).

Farming only []

(b). Civil servant and farming []

(c). Business man and farming []

(d).Others (specify):.....

13. What type of farm enterprise do you practice?

(a) Monocropping (maize only) []

(b) Mix cropping [] (List crops mixture):

(i)..... (ii)..... (iii).....

(iv).....

14. Do you have access to credit facilities (a) Yes [] (b) No []

15. If yes, give amount of credit received from 2009 – 2011:

Naira.....

16. What are your other sources of funds apart from credit facilities from 2009-2011?

(a) Personal saving [].Amount:.....Naira .

(b) Family members [].Amount:.....Naira.

(c) Gifts from philanthropists []. Amount:..... Naira

17. Are you a member of any co operative society? Yes [], No []

18. If yes, give the number of years you have been an active member:.....years.

19. What are the benefits derived as a member of cooperative societies?

(a)-----

(b)-----

(c)-----

20. Have you been visited by extension agents since 2009-2011? Yes [] No []

21. If yes, give number of extension contacts since 2009-2011 (number): -----

SECTION C: LEVEL AND RATE OF ADOPTION OF STRIGA RESISTANT MAIZE PRODUCTION TECHNOLOGY (ADOPTER ONLY)

22. Below is a list of 10 recommended technological packages associated with adoption of striga resistant maize seeds, please indicate which package or packages you are adopting:

TECHNOLOGICAL PACKAGES	Tick	Year
1.Ridging: 75cm-90cm Intra row		
2. Planting: 15 th may- 30 th June		
3. Seed Rate: i.17kg-20kg for 1 plant per hole (Hand planting) ii. 34kg-40kg for 2 plants per hole (Hand panting)		
4. Spacing: Between rows: 75cm- 90cm. Between plants: i. 20cm-25 cm for 1 plant per stand ii. 30cm – 40cm for 2 plants per stand		
5.Seed Treatment: I. Dress seed with Apron plus (I sachet to2kg of seeds) ii.Dress with Apron star at I sachet/4kg of seeds.		
6. Fertilizer Application: i. Apply 120-150 kg of Nitrogen, 60kg of Phosphorus and 60kg of potassium per hectare. ii. Apply half of Nitrogen and all of the phosphorus and potassium at planting. iii. The 2 nd half of nitrogen is applied 4-5 weeks after planting.		
7. Weeding: i. Hand weeding 2-3 weeks after sowing and 2 nd weeding at 6 weeks after planting. ii. Chemicals control: Use Primextra 500FW/ Primagram 500Fw/ Babamaize 550FW (Any at 5 litres/ ha pre -emergence) and Stamp 500EC at 4 litres/ha pre –emergence not later than 2 days after planting		
8.Pest and Disease Control: i. Stemborers use furadan ii. Termites: Apply dieldrin or aldrex T. iii. Birds: Use birds scarers		
9. Harvesting: Remove cobs from stalk and sun dry before threshing.		
10.Storage: Store in drums, jute bags and plastic containers and treats with any of these: Actellic 2% dust, Actellic 25 Ec or photoxin.		

23. Which year have you been using striga resistant maize production technology? -----

24.How did you get in contact with this seed?

(a) KADP extension agents []

(b) Friends []

(c) Co operative society []

(d) Radio []

(e) T.V []

(f) Printed materials []

(g) Others (specify).....

25. In your opinion what are the advantage(s) of using striga resistant maize production technology (a).....

(b).....

(c).....

(d).....

26. Do you use any of the following soil management practices on your farm land?

Yes [], No [].

27. If yes, please indicate the soil management practices used:

(a) Green manuring []

(b) Mulching []

(c) Crop rotation []

(d) Bush fallowing []

Others specify :(i)..... (ii)..... (iii).....

SECTION D: STRIGA RESISTANT MAIZE OUTPUT

Farm Size and Output from Striga Resistant Maize Production Technology in 2010.

28. Farm size for striga resistant maize production in 2010:.....(Hectares).

29. What was your average output of maize before the adoption of striga resistant maize? 100kg/bags from an equivalent farm size of your maize production.

30. What was the estimated price of 100/bags of maize before the adoption of striga

resistant maize?..... Naira.

31. What was the output from striga resistant maize production in 2010:.....

.....of 100kg/bags from the farm size given in question 28.

32. What was the highest price of 100kg/bag in 2010?.....Naira

33. Has the production of striga resistant maize improved your standard of living in terms of property acquisition? Yes [☐] No [☐].

34. If yes, please list the types of property acquired:

(a) -----

(b) -----

(c) -----

(d) -----

SECTION E: CONSTRAINTS TO ADOPTION OF STRIGA RESISTANT MAIZE

(ADOPTERS ONLY)

35. Do you experience any constraints in your striga resistant maize production?

Yes [☐] No [☐]

36. If yes, please list your constraints:

(a) -----

(b) -----

(c) -----

(d) -----

(e) -----

37. As an adopter, suggest ways by which the above constraints can be solved to

improve the adoption of striga resistant maize production:

.....

.....

.....

.....

.....

Farm Size and Output from Non-adopters of Striga Resistant Maize Production

Technology

(For Non- adopter of Striga Resistant Maize Production Technology Farmers)

38. Farm size for non- striga resistant maize production in 2010.....(Hectares).

39. What was the average output of maize? (100kg/bags per hectare).

40. What was the highest price of 100kg/bag in 2010?.....Naira.

41. Has the production of maize improved your standard of living in terms of property acquisition? Yes [☐] No [☐].

42. If yes, please list the property acquired:

(a) -----

(b)-----

(c)-----

43. What are your constraints in maize production?(For both adopters and non-Adopters)

.....

.....

44. What are your suggestions for how to improve maize production in this area?

.....
.....
.....

Thank you for your cooperation.

Aloko, A.B.