

**FACTORS INFLUENCING ADOPTION OF RECOMMENDED IRISH
POTATO PRODUCTION PRACTICES IN KUDAN AND GIWA LOCAL
GOVERNMENT AREAS OF KADUNA STATE, NIGERIA**

BY

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DECLARATION

I hereby declare that this dissertation titled “**Factors Influencing Adoption of Recommended Irish Potato Production Practices in Kudan and Giwa Local Government Areas of Kaduna State**” has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed information has been duly acknowledged in the text and a list of references provided.

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CERTIFICATION

This dissertation titled ‘**Factors Influencing Adoption of Recommended Irish Potato Production Practices in Kudan and Giwa Local Government Areas of Kaduna State**’, by **Garba UMAR** meets the regulations governing the award of the Degree of Master of Science in Agricultural Extension and Rural Sociology of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to Almighty Allah (SWT) who created the universe and the creator of all creatures and my beloved late parents Umar Abubakar and Aishatu Umar may Almighty Allah (SWT) grant their souls an eternal rest Amin.

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ABSTRACT

The broad objective of this study is to examine the factors influencing adoption of improved Irish potato production practices in Kudan and Giwa Local Government Areas of Kaduna State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of Irish potato farmers in the study area, examine the different sources of information through which farmers learn about recommended Irish potato production practices, assess the level of adoption by farmers, determine the effect of socio-economic, institutional and technological factors on the adoption by farmers, examine the effect of adoption on income and yield of non-adopters and adopters; and to describe the constraints faced by farmers in the adoption of recommended Irish potato production practices in the study area. A multi-stage sampling technique was used for this study. The first stage was the purposive selection of two (2) Local Governments Areas. Secondly, six villages were purposively selected, two from each LGA, Finally, a simple random sampling was employed in selecting the respondents who are adopters of recommended Irish potato production practice and those who are non-adopters. Primary data were collected from 160 farmers through the use of random sampling techniques with the aid of structured questionnaire. Tools of analyses used were description statistics (such as frequencies, percentages, and means) and inferential statistics such as multiple regressions and Z-statistic. Results of data analysis reveal that the mean age of adopters and non-adopters were 43 and 42 years, respectively. Approximately 59% of adopters and 65% of non-adopters had some form of formal educational qualifications. It was found that majority (31%) of the farmers acquired information about the recommended Irish potato production practices through extension services. The mean adoption level was 4 which fall within the moderate level of adoption. Farmer's level of adoption was observed to be at the moderate level. The results of the multiple regression analysis revealed that age, household size, farm size, farming experience, access to credit, information sources, membership of association, relative advantage index, compatibility index and complexity index were the socio-economics, institutional and technological factors that influence the adoption 65% of recommended Irish potato production practices by farmers in the study area at various significant levels. From the result of Z-statistic it was found that the mean difference for yield and annual farm income non-adopter and adopter of the recommended Irish potato production practices was statistically significant at 5 and 1% levels of significance, respectively. It was concluded that adoption had significant impact on the yield and income of the adopters. Finally, insufficient capital was ranked as the foremost constraints faced by farmers in the adoption of recommended Irish potato production practices in the study area, it was therefore, recommended that farmers should be encouraged to diversify their livelihood activities by engaging in non-farming activities in order to augment farm family income and thereby increase productivity.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture is the main stay of Nigeria economy. It is a catalyst for the overall development of the country (Ogbalubi and Wokocha, 2013). Thus, it is a critical sector that drives the economic development and industrialization. The role of agriculture in hunger and poverty reduction remains the subject of debate, especially the part that produces food, is linked to poverty alleviation and human development.

Even though agriculture is the main source of livelihood for 2.5 billion people, including 1.3 billion smallholders and landless workers, public investment in developing countries as well as the share of agricultural expenditure in total government spending, have been gradually declining since 1980s. The growth of agricultural productivity has stalled. The yields of major crops grow by about one percent per year, which is lower than the population growth rate. Given that expanding the cultivated area is not a possibility to meet future needs, in order to feed the growing population (World Bank, 2011).

Nigeria is predominantly an agricultural country (Ndanitsa *et al.*, 2009) having about 80 to 90 percent of its rural population involved in agricultural food production (Akpan, 2009), nevertheless, Ashigidigbi *et al.* (2011) reported that Nigeria have food demand exceeding its local production. This indicates that Nigeria lags far behind in providing food for her ever increasing population. Nigeria therefore is faced with a great challenge in terms of inadequacy of food supply.

It therefore becomes imperative to encourage the production of high yielding crop such as Irish potatoes.

Irish potatoes (*Solanum tuberosum* L.) is the world's fourth largest food crop after wheat, rice and maize (Raemaekers, 2001). World production reached a record of 320 million tons in 2007 and production in the developing countries has almost doubled since 1991, with a corresponding increase in consumption (Sofyan *et al.*, 2007). Potato is an important source of food, employment and income in developing countries (FAO, 2008).

Irish potato's high energy content and ease of production have also made it an important component of urban agriculture which provides jobs and food security to some 800 million people globally (Sofyan *et al.*, 2007). Hundreds of millions of people in the developing countries including Nigeria are facing food crisis as the cost of their staple foods continues to rise. Rice prices have almost doubled during the year 2008, as wheat prices are climbing rapidly while maize prices are skyrocketing. But On the contrary, the price of potato has remained stable. The potential of the Irish potatoes is yet to be fully realized and has never been more evident until the recent rising prices of rice, wheat and maize (FAO, 2008). Potatoes have the potential to relieve the pressure of increasing cereal prices on the poorest people and contribute significantly to food security. Potatoes are grown and eaten locally, with little significant international trade compared to cereals, so they are particularly valuable as food in the developing countries. Potatoes mature in 3-4 months and can yield about 40 tons/ha and hence ideally suited to places where land is limited and labour is abundant (FAO, 2008). Potatoes have less significance in international trade compared to cereals and therefore they can form a significant source of food in developing countries.

Maganga (2012) has pointed out that the Irish potato sector can help improve the incomes of smallholder farmers and subsequently curb food insecurity together with poverty. This is partly because potatoes are grown and consumed locally, mature within a short period (3-4 months) and have high yield (about 40 tons/ha). Additionally, potato can be grown in areas with limited land and abundance of labour (FAO, 2008).

Planting material: The following are the improved varieties used in the study area, Ajax (for rainy season), Romanoc and RC767-2 (for rainy and dry seasons).

Planting date: Plant as early as the rains are steady (May to early June).

Method of planting: Make ridges of 15-30cm (6inches -12inches) high, spaced 2ft (60cm) apart. Plant sprouted big-size healthy tubers spaced at 30cm in rows, 5-7.5cm deep for big size tubers and small size tubers for smaller size tuber yield. In case of single rows, leave 2ft (60cm) cm to 3 ft (90cm) apart and incase of double rows leave a space of 6ft (180 cm) to the next row.

Planting space: Plant on ridges 75-90cm apart and 30cm between stands at one plant per stand.

Fertilizer application: Use NPK Fertilizer 20:10:10 at the rate of 8bags plus 2bags of SSP or 8bags of SSP+ 3.5bags of Urea per ha applied at spouting.

Weeding: 1st weeding should be done at 3WAS and moulding of the ridges 4 weeks later for good tuber formation. The farmer may use the following herbicides: Sencor 50WP at 0.9kg in 300Litres of water/ha and Enide 50WP at 1.10kg in 300Litres of water/ha, all applied pre-emergence.

Harvesting: Harvest when the leaves turn yellow through mechanical (harvesters).

Given the importance of Irish potato in food security and poverty alleviation, low productivity remains a major challenge in its production. This implies that technological advances generated through research Institute have not widely translated to full adoption. Therefore, assessment of underlying factors affecting adoption of technologies need to be considered.

1.2 Problem Statement

Irish potato is a crop of major economic significance worldwide. This crop provides a reliable source of income, employment and food for many populations in the developing countries (FAO, 2008). Globally, potato provides food security to an estimated 800 million people (Hoffler and Ocheng, 2009). Given the importance of Irish potato production, it is one of the realistic venture which should be promoted not only for food security but also to ensure increased revenue for farmers. With increasing population and low output from agricultural land, adoption of improved agricultural technologies and modern method of farming is importance for increased output.

One important way to increase agricultural productivity is through the introduction of improved agricultural technologies and management systems. However, the challenge of agricultural researchers is to understand how and when new technologies are used by farmers. It is therefore pertinent to understand the mechanisms underlying technology adoption. One of the major challenges facing agricultural policy makers is the need for the investigation of those economic factors which contribute to the adoption of new and/or improved farm technology.

Although investments have been made in research and development in an effort to improve Irish potato productivity of smallholder farmers, these efforts have focused on development and adoption of high yielding varieties. Yet low productivity remains a

major challenge - the average national farm level yields. This implies that technological advances generated through research have not widely translated to increased efficiency and improved resource productivity.

Interestingly, the National Root Crop Research Institute (NRCRI), Vom and other agricultural research institutions in Nigeria and abroad have made notable achievements in increasing the yield of Irish potato. The crop breeders have developed varieties of Irish potato, which are capable of responding to improved cultural practices. They have gone a long way towards solving the pests and diseases problems both in the field and storage (Okonkwo, 1992). In order to sustain these, adoption by farmers become necessary. The efforts made to develop improved agricultural technologies are not considering the benefactors as well as the factors influencing adoption of these technologies. The Research institute has also been working very closely with agricultural extension system and other stakeholders in the area in trying to disseminate these technologies to farmers (Kanyeka *et al.*, 2007). However, despite of the efforts done, there is dearth of information on the factors hindering or promoting their adoption. Based on the foregoing this study provided answers to the following research questions.

- i. what are the socio-economic characteristics of Irish potato farmers in the study area?
- ii. what are the different sources through which information reach farmers on recommended Irish potato production practices?
- iii. what are the levels of adoption of recommended Irish potato production practices by farmers in the study area?

- iv. what are the socio-economic, institutional and technological factors influencing the adoption of recommended Irish potato production practices by farmers?
- v. what are the effects of adoption of recommended Irish potato production practices on yield and income of adopters and non- adopters?
- vi. what are the constraints faced by farmers in the adoption of recommended Irish potato production practices?

1.3 Objectives of the Study

The broad objective of this study was to determine the factors influencing the adoption of recommended Irish potato production practices by farmers in the study area. The specific objectives were to:

- i. describe the socio-economic characteristics of Irish potato farmers in the study area;
- ii. examine the different sources of information through which farmers learn about recommended Irish potato production practices;
- iii. assess the level of adoption of the recommended Irish potato production practices by farmers;
- iv. determine the effect of socio-economic, institutional and technological factors on the adoption of recommended Irish potato production practices by farmers;
- v. examine the effect of adoption of recommended Irish potato production practices on yield and income of non- adopters and adopters and;

- vi. identify the constraints faced by farmers in the adoption of recommended Irish potato production practices.

1.4 Justification of the Study

Irish potato is an important staple food as well as raw materials for industries. In order to meet the demand for industrial and human consumption, the yield per hectare needs to be improved. Such imminent improvement could be achieved through adoption of improved technologies. Irish potato is by far the most fruitful and efficient tuber crop in the world in terms of tuber yields and days to maturity. The crop matures in about 60 to 90 days as compared to 9 and 12 months for yam and cassava, respectively (NRCRI, 2005). Kudi *et al.*, (2008), maintain that the Irish potato gives the highest yield per unit area among roots and tuber crops in Nigeria and that it brings more income to farmers than other roots and tuber crops. It is important to assess the current level of adoption of improved technologies in Irish potato production among farmers. It is envisaged that this study would validate the significant of adoption of recommended practices in Irish potato production.

The finding of this study is expected to provide a guide to assist farmers on areas to explore Irish potato production for increased yield and economic benefits. This is because farmers' decision towards the production or adoption of any crop or technology is influenced by their expectation of economic benefits. Vabi and William, (1991) maintain that farmers who adopted a particular production method of crop do so in anticipation of economic benefits.

Agricultural technology adoption study has many policy implications in agricultural development. It serves as a tool for evaluating the distributional impacts of new innovations, for documenting the impact of an innovation or extension effort, for

identifying and reducing the constraints to adoption, and as a research guide to focussing innovation priority (Doss, 2003; Langyintuo and Mungoma, 2008). It is expected that this study would provide a useful framework for assessing farmers' practice of adoption behaviour thereby provide a feedback for by extension workers and Research institutes. The policy makers would also find the results of this study useful for appropriate policy formulation and development. Also, this research work hopes to provide information to the donors/prospective stakeholders, the government, the project managers and the farmers involved in the planning, funding and implementation of agricultural development projects. The indicators would inform each of the stakeholders the level of adoption and factors that influenced farmers' adoption behaviour thereby provide information for the correct course of action and appropriate improvement to be put in place. Furthermore, the findings of this research would contribute to the existing literature, especially on agricultural technologies adoption studies, which would serve as a tool for consultation and subject of further research activities.

1.5 Hypotheses of the Study

The hypotheses tested in this study were:

- i. There is no significant relationship between the Socio-economic characteristics, Institutional factors and adoption of recommended Irish potato production practices.
- ii. Adoption of recommended Irish potato production practices had no significant impact on the yield and income of non-adopters and adopters.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin of Irish potato and its Characteristics

Irish potato (*Solanum tuberosum* L.) belongs to the solanaceae family. It is a native of Western Hemisphere and is believed to have originated somewhere between Mexico and Chile, possibly in Andes highlands of Bolivia and Peru. It later spread to other places like England and Ireland. The planting stock has been received from Ireland, hence the name Irish potato. Irish potato was introduced into Nigeria in the later part of the 19th century and early 20th century by the Europeans notably the tin miners in the Jos Plateau (Okonkwo *et al.*, 1995). Irish potato is grown for food as well as a commercial crop. It is a major source of income among the rural farmers in many African communities. The crop is efficient in converting land, labour, water and capital into a highly nutritious food. This is not surprising if for no other reason than it has a shorter growing cycle of about 95 days than most other tuber crops in the tropics (Wuyep *et al.*, 2013).

2.2 Socio-Economic Characteristic of Farmers on Adoption of Recommended Practices Irish Potato Production

Adoption of agricultural innovation depends on socio-economic characteristics of farmers. They include farmers' specific demographic characteristics such as age of the household head, educational level, family size, marital status and gender of the household head, access to credit services as well as access to extension services. All these factors have shown to be significant in determining farmers' decision to adopt a technology. Ayodele (2000) found that the mean age of the Irish potato farmers was 41 years with majority of them (50.8%) within the age group of 40-49 years, while the active and virile age group of 30-39 and 20-29 were significantly low implying that

many of the youths in the area were not engaged in farming. That most of the farmers were small scale because the mean farm size was 3ha with most of the farmers cultivating between 2-2.99 ha (31.7%) and closely followed by 3-3.99 ha (22.5%) while, the mean household size was 6 persons, with the maximum of 20 persons. Farming experience was average 18 years.

Jwanya *et al.* (2014) in their work on the Economic Analysis of Irrigated Irish Potato Production in Plateau State, Nigeria stated that about 58% of the respondents were adults who have had several years of experience in Irish potato irrigation farming. Their long years of experience coupled with their age. Majority (84%) of the respondents were men. About 34% and 30% of the farmers have had secondary and higher education, respectively. Majority (97%) of the farmers had over ten years of experience in Irish potato irrigation which implies that the farmers were aware of all the nitty-gritty's involved in the enterprise, while about 90% of the farmers had high family size ranging from six to above ten household members, the large family size implies availability of free family labour, thus, the reason for the lower cost of labour as compared to cost of seeds and fertilizers in the business. The average farm size per farmer was 0.7 Ha which implies either an unavailability of capital or management ability of the farmers to control large farm size or the existence of a stiff land ownership system that hinders farmers from acquiring larger irrigation farm lands.

Njuguna *et al.* (2015) in their work on influence of demographic characteristics on adoption of improved Irish potato varieties by smallholder farmers in Mumbarisi Division, Kenya reported that most of their respondents were males indicating that many of the households are male headed. Majority of the respondents were aged between 20 and 40 years with average age of 34.22 years. Their results also showed that

most of Irish potato farmers had at least primary level of education with average year in school being 1.59. Many of the households had family sizes of between 5 and 9 members with average family size of 5 members. Only 17 percent of their respondents were able to access extension services.

Kudi *et al.* (2010) in their work on analysis of adoption of improved maize varieties among farmers in Kwara State, Nigeria stated that seventy six percent of the farmers had contact with extension agent, while twenty four percent had no contact with extension agent. This implies that the more the contact with the extension agents the more the adoption rate. Their result also indicates that eighty percent of the respondents had access to credit, while twenty percent had no access to credit. Kudi *et al.* (2010) argued that there is that tendency that farmers will adopt new innovations because majority of them had access to credit which would enable them to purchase inputs and pay for labour required in the adoption of new varieties.

2.3 Sources of Farm Information on crop production

There are many sources of farming information available to farmers. A study by Kabungo (2008) in Mbeya Rural District, Mbeya Region, Tanzania, reported that about 52% of the respondents indicated to be readily accessible to extension services, while 37% said that they were accessible to credit services. These observations indicate low accessibility to extension and credit services by a significant proportion of farmers in the area. Lack of accessibility to extension and credit services have been reported in many parts of Sub-Saharan Africa as well as other developing countries as the limiting factor for increased agricultural productivity (Eze *et al.*, 2006; Junge *et al.*, 2009; Okoedo-Okojie and Onemolease, 2009). When asked how they perceive market for Irish potatoes farming, an item thought to be an incentive for increased

production and consequently adoption of improved technologies (Yohannes *et al.*, 1993), nearly half (45%) of the respondents were of the opinion that market for Irish potatoes is good, reflecting good market for this crop from the area. Although membership to organization (i.e. Cooperative membership) is considered as important information source including farming among farmers (Salasya *et al.*, 2007; Agwu *et al.*, 2008; Odoemenem and Obinne, 2010) results from this study revealed that only 28% of the respondents were members of organizations (i.e. farmers groups). This information shows that the potential of social-network (social capital) through farmers group as source of agricultural related information has not been fully utilized in the area.

Yahaya and Aina (2007), found that most of the cassava farmers (97%) have access to information from extension agents. Fadiji (2000), reported that radio communication was recognized as the most accessible and potentially useful means of disseminating information. According to him, radio has a high capacity for creating awareness of new innovations and for stimulating farmers to become more actively involved.

Odoemenem and Obinne (2010) opined that the sources of information on improved cereal crop technology package available to the farmers included extension workers, fellow farmers/neighbours and mediated information sources. The primary goals of these information sources are to create awareness by diffusing among potential adopters useful and practical information on the innovation and encourage its application. Agricultural extension workers constitute the most important source of information to the farmers as 40.54% of them obtained information from the extension services.

2.4 Level of Adoption of Irish Potato Recommended Practices by Farmers

Feder *et al.* (1985) defined adoption as the degree to which new technology is used in long-run equilibrium when farmers have complete information about the technology and its potential. Therefore, adoption at the farm level indicates farmers' decisions to use a new technology in the production process. Rogers (1995) defined adoption as "the decision to make full use of an innovation or technology as the best course of action available.

Agwu *et al.* (2008) found that seeding rate, timely sowing and fungicide application were the highly adopted Irish potatoes technologies; about 92%, 100% and 80% of respondents indicated to have adopted these technologies, respectively. Improved varieties and pesticide application were moderately adopted technologies. These technologies were used by 58% and 51% of the surveyed households, respectively. Recommended chemical fertilizer application rate as well as folial/booster fertilizer application, together with recommended spacing were the least adopted technologies. While none of the surveyed households adopted the recommended spacing rate, the other two technologies were adopted by only nearly one- third of the surveyed households. Furthermore, when data analyzed by number of technologies adopted (i.e. overall adoption). It was noted that a significant portion of respondents (50%) had adopted not more than three technologies out of eight. Therefore, it is evident that several technologies for improved agricultural technologies for Irish potatoes farming are available in the area. However, extent of adoption of most of these technologies and total number of technologies adopted (overall adoption) is not satisfactory. This trend is responsible for the existing low productivity per acre for this crop in the area observed in previous studies (Kabungo, 2008). It is well known that in sub-

Saharan Africa low agricultural productivity by small scale farmers, among other to have been contributed by poor adoption of improved agricultural technologies.

The rate at which innovations are used by farmers is largely dependent on sensitisation, mentoring and demonstration by extension agents (Lawal and Oluloye, 2008). The work of Lawal *et al.* (2005) conducted in some villages in the Southwest Nigeria recorded high adoption rate (about 56.7%) of improved varieties of seeds. Other study in this area (Omobolanle and Samuel, 2006) reported low adoption rate of improved crops technology as a result of low research and extension outreach to farmers. Studies across the country showed that where awareness was high and extension contact was more than 60%, adoption of agricultural technology is usually more than 50%.

Ekong (2005) found that the rate of adoption of improved rice variety (F-44) in 2004-2006 was 11 percent. Agbamu (2006) also found the rate of adoption of improved maize variety in 2004-2005 was 52 percent. Similarly, Ephraim (2002) found the highest rate (43%) of adoption of cassava production innovations in 2001, was the use of late planting period. Rate of adoption, according to Rogers (1995) is the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the ratio of adopters of a new idea for a specified time period multiplied by 100.

Rogers (1995) found that the rate of adoption is influenced by the farmer's perception of the attribute of the innovations. Result of adoption research can be used by extension organizations to accelerate the rate of adoption of innovations or to change the adoption process in such a way that certain categories of farmers adopt innovations more rapidly (Van and Hawkins, 1996). Hence it may be necessary to develop different extension messages for different categories of farmers.

Van and Hawkins (1996) found that adoption rate clearly showed the adoption behaviour of farmers in the given area. Some farmers adopt immediately the practice is introduced while others adopt at different times later. Yusuf (2009) found rate of adoption of improved groundnut oil processing technologies by rural women in Kaduna State to be relatively higher, because the technologies were easy to operate and it improved their income. High rate of adoption means the technologies were exceptionally useful, appropriate to the respondents in the study area.

The rate of adoption of recommended practices is the percentage of the farmers that adopt a particular recommended practice. It also shows how many components of the recommended practice which majority of the farmers in a given area adopt (Ogunbameru, 2001). It is a presumption that farmers will adopt any improved and proven agricultural technology.

In extension communication, farmers who responded to campaigns and adopted the cultivation of an improved maize variety were rewarded with higher yield and increased income. This will make the same farmers and others in their neighbourhood to be receptive to adoption of agricultural innovations which may be brought before them in the future (Agbamu, 2006).

2.5 Factors Influencing Adoption of Irish Potato Recommended Practices by Farmers

In Nigeria, empirical studies on agricultural technology adoption suggest that factors such as socio-economic characteristics of farmers, access to credit or cash resources and information from extension and other media influence adoption rate of new agricultural technology among farmers (Ayinde *et al.*, 2010; Idrisa *et al.*, 2012).

For example, Ayinde *et al.* (2010) found that education level of farmers; farming experience; farm size; access to extension agents and access to credit have significant and positive influence on adoption.

Namwata *et al.* (2010) in their work on the factors influencing the adoption of improved agricultural technologies for Irish potatoes among farmers in Mbeya Rural district, Tanzania. The sign of all coefficients were on the expected direction, only some variables were found to be significantly associated with the number of technologies adopted. Increased household income was significantly positively associated with adoption of improved technologies (i.e. number of technologies adopted). Sex and marital status were significantly positively associated with adoption of improved technologies. Positive association between marriage and adoption of improved technologies could be attributed the desire to meet increased household needs as a result of marriage by increasing production. Other variables that were significantly positively associated with adoption of technologies were increased farming experience, access to extension services and access to credit services (receipt of credit). Effect of education, age, household size, farm size, membership to organization, perceived market for Irish potatoes and distance to market centre were not significant, indicating that they were not important predictors of adoption of improved technologies in the study area.

Njuguna *et al.* (2015) reported that family size was a significant factor influencing adoption of improved potato varieties. Large families provide readily available and cheap labour which is important in adoption decisions. Improved potato farming is labour intensive especially during peak seasons that is, planting, weeding and

harvesting. Availability of cheap labour thus will enhance adoption (Mathni and Namgongo, 2009).

Studies on socio-economic characteristic of farmers carried out in Nigeria have shown that there exists a close association between farmers' socio-economic characteristics and awareness of adoption of recommended farm practices. The review of the literature also finds that the status of the farmer in terms of his assets, wealth, population of the family, farm size, income, extension contact, and the exposure are among the indices that determine the acceptance and the adoption of improved farming practices. Yahaya (2002), reported that farmers between the ages of 20-50years are the most active age group in agricultural production. Aghamu (1993), observed that age, in correlation with farming experience, has a significant influence on the decision making process of farmers with respect to risk aversion, adoption of recommended production practices and other related decisions. Yahaya (2007), observed that it is generally believed that males are often more energetic for energy demanding activities such agricultural activities while Oladele and Kareem (2003), opined that gender pose no barrier to active involvement in farming activities. Ojuekaiya (2001), in his classification of farm size opined that farmers who cultivate farmland between 1.0-5.9 hectares are small-scale farmers.

Farmers' response to agricultural innovations are attributable to certain institutional factors influencing adoption such as extension contact, access to credit, input delivery and sources of information. Osuagwu (2002), found a significant and positive relationship between the frequency of extension agents' visit and the adoption of improved farm practices. Also, Williams (1982), found that farmers first learn of some recommended farm practices through extension workers. Akanya (1989), found

extension contact and credit facilities to be positively and significantly related to awareness, adoption and gross farm output of farmers. Camboni and Napier (1993), opined that relative economic advantage, compatibility and complexity of innovations, appropriateness of technology are major factors that could influence the acceptance and usage of a technology.

Many researchers have confirmed the role of credit in adoption of recommended practices. Chikwedu *et al.* (1993) found that credit had a positive influence on adoption. This may be due to the fact that improved new technologies do come with some recommendations which require money for their implementations, with limited financial resources associated with Nigerian farmers, access to credit is likely to negatively influence farmer's adoption of improved technologies (Yusuf, 2009). Benjamin (2010) found that credit from informal institutions was the major influencing factor in adoption of recommended cassava technologies. Adesina and Forson (1995); Omonona (2009); Erado *et al.* (2004) discovered that access to credit affects household welfare outcomes through at least two channels: first, it alleviates the capital constraints on agricultural households. Access to credit also reduces the opportunity cost of capital intensive assets relative to family labour, thus encouraging labour – saving technologies and raising labour productivity, a crucial factor for agricultural development, especially in many African countries (Zaller *et al.*, 1997). The second channel, through which access to credit affects household welfare, is by increasing its risk- bearing ability and altering its risk- coping strategy. Polson and Spencer (1990); Baidu-Forson, (1999); Aliou *et al.* (2000) and Benjamin (2010) confirmed that rural farmers are not able to adopt most modern production technologies because they are relatively poor. Therefore, for them to adopt most technologies, they must require subsidy and credit.

Family labour is still an important component of labour for small farmers. Saddiq (2008) revealed that family size greatly influenced the adoption of improved agricultural practices. This is because farmers with larger family size had more responsibility to care for more people. Agbamu (1995) reported a positive relationship between family size and adoption of soil management practices but this relationship was not significant. Ogunfiditimi (1981); Agbamu *et al.* (1996); Ani (2008) and Odoemenem (2010) found that the economic status of the farmers had a positive and significant relationship with adoption of improved practices which portray the fact that the more the farmers are well-off economically (in terms of their ability to purchase necessary input such as insecticides, fertilizers, and labour), the more they are prone to adoption of new practices. If a farmer can try out an innovation without committing too much money, he may adopt it more quickly. For example, new seeds, fertilizers and herbicides can be purchased in small quantities and tried out on a limited scale (Agbamu, 2006).

Studies have shown that when other factors are held constant, there is obvious positive relationship between level of income and adoption of agricultural innovations. The higher the income level of a farmer, the lesser he or she will be disposed due to the fear of taking a risk in respect of adopting a given technology. The finding of Ani *et al.* (2008) which confirmed that farm income made significant contribution to adoption corroborates that of Agbamu *et al.* (1996). The poor economic status of most Nigerian farmers has inhibited the adaptation of most agricultural technologies. An innovation perceived as advantageous may not be adopted because of its cost. It is necessary that for any extension programme to succeed there is need for a thorough understanding of cultural situations within which the farmer is operating, more especially the institutional arrangements in operation at the villages where the bulk of farmers live.

Atala (1980) and Ekong (2005) found size of farmland to be positively and significantly related to adoption of innovation. Land ownership structure is an important factor that can affect the adoption of a new technology. The importance of land in agricultural and food production cannot be overemphasized. To this effect, farming cannot take place without land (Ekong, 2005). He also maintained that farmers can be indifferent in adopting new technologies if the land tenure system does not allow personal ownership of land to execute the technology. Tenureship of land is also related to the size of land owned by a farmer. Studies have shown that in America, size of farm is always positively related to the adoption of new practices by the farmers. According to Rogers and Svenning (1969) and Lawrence *et al.* (1999) one major factor of excellence in farming in Colombia is the farm-size, whether measured in land or labour input. Their report showed a positive correlation of farm-size with adoption.

Akpoko (2001) also found that household size contributes positively to adoption of recommended practices. Household size is the total number of individual (wives, children or grandchildren and extended family members) that live with and feed from the household. The adoption index may be either household size depending on the magnitude, age structure and available farm labour among members. Adesina and Baidu-Forson (2009) revealed that farmers adopt agricultural innovations because they have more mouths to feed. And the family serves as labour source for agricultural production.

2.6 Theoretical Framework

This study is guided by the social change theory, using the adoption and diffusion perspectives.

2.6.1 Theory of Social Change

Social change is an ever present phenomenon in any society. It is the essence of human existence, development and growth (Robinson, 1982). Moore (1963) sees a social change as the significant alteration of social structure in the society. Rogers (1983) posits that social change is the process through which significant alteration occurs in structure and function of the society. The process of change involves interaction and so individuals must be understood in terms of the group in which they belong or participate. Saltman (1972), defined social change as a term used to describe change in social and economic lifestyle and values of people, technological innovation and social institutions.

Ekong (2003) defined social change as the modifications in human attitudes and behaviour pattern as a result of education (such as extension activities). Changes do occur daily in the social system which affect the behaviour of people, and social change theorists believe that for change to take place, societies have to move from traditional ways of doing things to modern ways.

Social change may be planned or unplanned (i. e accident). Planned change entails the direct human intervention in the shaping and direction of change toward some predefined goals. Change may also be total or segmental in its coverage. Total change is that which covers a wide range of activities and may lead to a complete transformation of a people's way of life or their social institutions. Segmented change as the name implies covers only a particular portion and may not call for a total transformation of the system. The specific meaning of social change varies depending on the social entity considered. Thus, for this study, the social change theory will help to analyze the

changes in output, income and level of living of farmers as a result of adoption of recommended practices in Irish potato production.

The adoption of recommended Irish potato production practices is a planned social change because extension agents deliberately seeks to introduce improved varieties recommendation for the benefit of the farmers. Social change perspective will be used to explain the socio-economic characteristics of Irish potato farmers which will also help to determine the factors influencing adoption of Irish potato recommended practices by farmers. Furthermore, this perspective will also be used, to explain the introduction of improved Irish potato recommended production practices through different sources of information aimed at improving productivity. This new practice is proposed to be used to substitute the old ones.

2.6.2 The adoption – diffusion perspectives

The key area this research work seeks to address is on adoption and diffusion of agricultural innovations. Adoption according to Rogers (1995), is the decision to make full use of an innovation or technology as the best course of action available. Adoption of a new agricultural innovation or practice requires that the farm operator must be aware of the practice, become interested in it, evaluate it, try it out and then take step of adoption. Diffusion according to Daniel (1997), is the process by which an innovation is adopted or gain acceptance by members of a community. David and David (2000), in their view opined that diffusion could be interpreted as aggregate adoption.

Adoption is the decision to continue full use of an innovation after an individual has passed through certain mental processes. Adoption is the acceptance of continued use of an innovation after individuals or groups had gone through certain mental processes (Agbamu, 2006).

There are several models of explaining the adoption process. One of the models is that accepted by the United States of America North Central Rural Sociology Committee of Iowa in 1995 and which recognized the following sequence for explaining the process of innovation adoption. Awareness - Interest - Evaluation - Trial - Adoption (Ogunbameru, 2001). After the first four stages, the fifth stage is the adoption in which a decision is taken on whether to accept agricultural technology or not.

Awareness stage is the first stage; here the farmer merely knows about the existence of an innovation but lacks details about it. This is somewhat like seeing something without attaching meaning or importance to it. Before a farmer can adopt a new idea or practice, the individual must first know about it. It is therefore the major task of the extension staff to bring the new idea, practice or technology to the knowledge of the farmer (Ogunbameru, 2001).

Interest is the stage that farmers seek more factual information about the idea, practice or technology due to the interest the farmer develops in the idea, technology or practice. The farmer wants to know what the technology is, how it works and also its potential or general merit. He becomes curious about it (Agbamu, 2008).

Evaluation stage: the farmer at this stage, shows marked interest in the idea, practice or technology as it applies to him. He mentally evaluates the applicability of the innovation in the light of the solution to his own problem situation. Farmers evaluate how the information or new practice affects their social, economic and cultural variables (values and conditions). If positive, they go ahead to the next phase. If negative, they stop there. They ask such question as: Can I do it? How can I do it? Is the new practice or technology better than what I am doing or using now? Will it work in my case?

What will I get out of it? All these and other questions flood their minds. They then make mental application of the idea. They obtain more information about the idea and decide whether to try it or not. Trial stage is the stage where the farmers have weighed the advantages and the risks involved and if the idea is divisible in small segments, they actually apply the innovation on a small scale under his' own circumstances and managerial competence. Such a trial could be done through the assistance of change agents and sales promoters (Agbamu, 2008) who also confirmed that this stage actually raises the questions: how I can do it? The farmer actually uses the innovation on a trial basis: it involves an experimental use of an innovation on a section of the farmer's plot of land. If the farmer is satisfied with the trial, he may decide to continue the use of that innovation. If the trial provides poor result, he may reject the innovation (Ogunbameru, 2001).

Adoption stage: it is the stage when a farmer has approved of an innovation and decided to continue using it. Adoption involves acceptance and repeated use of an innovation since the new practice brought an improvement on farm productivity or is expected to do so or will help to ease a difficult farm operation (Agbamu, 2008). Adegbenga and Babaleye (2009) argued that even when people have accepted an innovation, they remain curious until it has worked for some time and proved reliable. Similarly, the IITA (1988), reveal that the attributes of a technology as perceived by farmers determines the rate of its adoption. There are five attributes of a technology and these include: Relative Advantage, Compatibility, complexity, triability, and absorbability.

Relative Advantage: This is the degree to which a technology is perceived as better than the idea its superceed. The relative advantage is measured in economic terms but

often social prestige factor, convenience and satisfaction are also of importance. The greater the perceived relative advantage of a technology the quicker the rate of its adoption.

Compatibility: This is the degree to which a technology is perceived as consistency with the existing values, past experiences and needs of the farmers. A technology that is compatible will be adopted more rapidly than the one that is incompatible.

Complexity: It is the degree to which a technology is perceived as difficult to understand and used. Some technologies are easily understood by farmers while others are more complexed, hence can only be adopted slowly.

Triability: It is the degree to which a technology will be experimented with limited bases. A new technology that can be tried in an instalment plan will generally be adopted more quickly than a technology that is visible for trial.

Affordability: This is the last attribute of a technology where the result of the technology is seen physically. A successful result of a technology on a demonstration plot will convince farmers to accept and adopt it (IITA 1988). Madukwe (1991), opined that a group of farmers may be categorized according to their readiness to accept a new practice and put it into use as: Innovators, Early adopters, late adopters (Laggards) and Never Adopters.

Innovators: These are those who introduce new farming techniques into a farming community. They constitute a small proportion of the farming community. The source of their information may be through contact extension agents, the mass media or from what they have seen in another farming community.

Early Adopters: This group of farmers comes immediately after the innovators. Some of them are educated but may be conscious and would want to see the new technology tried under local condition. They usually express their interest and willingness but under conviction by result demonstrations.

Late Adopters (Laggards): This group of farmers is the third that can accept and try a technology. The percentage of late adopters is usually very high because of their conviction from result demonstrations. Although some take a much longer period to adopt.

Never Adopters: These are the last group of farmers that will neither accept nor adopt a new technology. They do not even consider what the extension agents try to put across them. This attitude may be due to factors such as illiteracy, poverty, conservative attitude, and lack of exposure, fear of tax payment as well as fear of risk of uncertainty (IITA 1988).

Having established trust in an innovation, there is no likelihood of discontinuance of its use. The implication of their findings to the adoption of recommended practice, there is need for awareness creation about the existence of the recommended practice. It should be one that can be tried on small-scale and which is better than old practice. To ensure that farmers sustain the adoption of an innovation, and not revert to old methods, there is need for occasional reinforcement of promotional campaigns about the good aspects of that innovation. However, it is important to note that, with the emergence of a superior innovation, farmers may discontinue the use of a previous innovation as they constantly seek better ways of doing things (Agbamu, 2008).

Adoption, according to Rogers (1995) and Arokoyo (2005) is the decision to make full use of a technology as the best course of action available. The farmers may decide to use a technology continuously over a time. The time taken for adoption varies with the nature of the technology, the communication of 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 (Agbamu and Orhorhoro, 2007).

Diffusion, according to Haralambos and Holborn (2008) is the process by which an innovation is spread among members of the community. Agbamu (2006) defined diffusion as the process by which an innovation is communicated through certain channels over time among members of the social system. According to him, a number of factors interact to influence the diffusion of innovations. These factors include: the innovation itself; the communication channels; the time; and the nature of the social system into which the innovation is being introduced.

2.6.3 Concept of Effect

Effect is a change or changed state occurring as a direct result of action by somebody or something else. The introduction of technologies to a social system is designed to achieve certain outcome. Whether this is achieved or not would depend on changes that are noticed among the target group (Adun, 1995).

Studies by (Philip *et al.*, 1990), revealed that improved farm equipment enables farmers to increase the land area under cultivation and achieve higher income. Similarly, Anazodo (1986), reported that adoption of improved farm equipment for crop production resulted in an increase in total production by improving yields, expanding the agricultural land area, increasing land use intensities and changing the nature of crop enterprises.

Berry (1993), stated that income is likely to increase, especially if production expands as a result of increases in yield per hectare and the adoption of cultural practices, which sustain soil fertility over time.

2.7 Conceptual Model

A model is a general conception of a phenomenon (Haralambos and Holborn, 2008). Asika (2001) observed that a conceptual framework is a construction that shows the relationship existing among variables and most often these relationships are depicted schematically and mathematically. The basic assumptions in this study are that farmers' socio-economic characteristics, institutional and technological factors would play a significant role in influencing adoption of recommended Irish potato production practices to bring about changes in the level of the farmers. In this model, the first arrow explains the relationship between the independent variables and the dependent variables while the dotted arrow shows the likely outcome of the relationship.

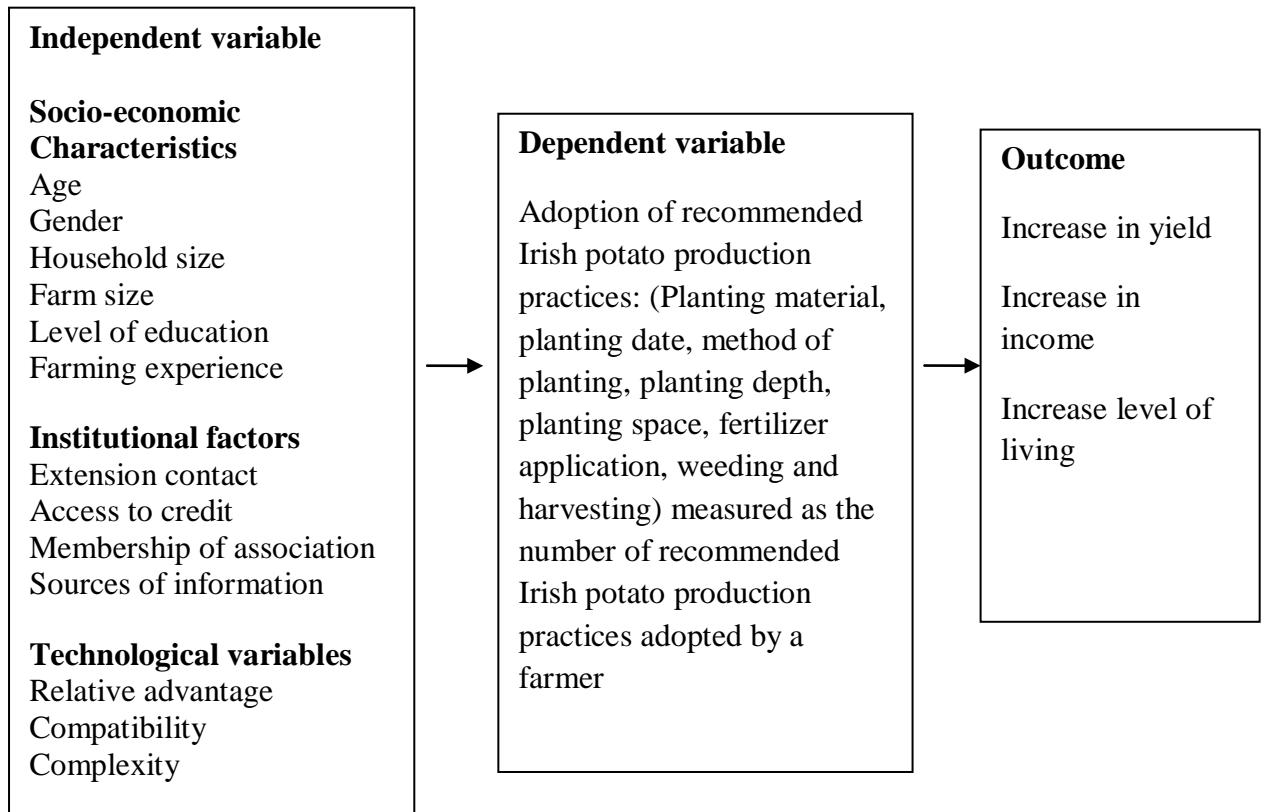


Figure 2.1: Model of factors Influencing Adoption of Recommended Irish potato Production Practices and Effects

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in Giwa and Kudan Local Government Area of Kaduna State. Kaduna State lies between latitudes $11^{\circ} 32'$ and $09^{\circ} 02'$ North of the equator and longitudes $80^{\circ} 50'$ and $06^{\circ} 15'$ East of the Prime Meridian (Kaduna State Statistical Year Book, 1996). The State occupies an area of approximately 48,473.2 square kilometres. The entire land structure consists of an undulating Plateau, with major rivers in the State as River Kaduna, River Wonderful in Kafanchan and River Gurara. The State extends from the Guinea Savanna in the South-Central to the Sudan Savanna in the North Central. The grassland is a vast region covering the southern part of the State. The State enjoys a rainy season of about five months. The length of the growing periods varies from 100 to 200 days. The dry season starts from October to May. Temperature in the state ranges between 28°C and 34°C (Kaduna State Metrological Station, 2012).

Giwa Local Government Area of Kaduna State is located in the plain of the Northern part of Kaduna State. It lies between latitude 12.20°N to 12.52°N and longitude 7.0°E to 7.5°E . The Local Government Area had an estimated population of 286,427 people in 2006 (NPC, 2006) with a projected population of 357,085 people in 2014 at a population growth rate of 3.2 per cent. The Local Government Area is blessed with floodplains popularly known as Fadama lands. These floodplains are characterized by availability and accessibility to both open surface and underground water. The mean annual rainfall varies from 635 mm to 1,524 mm. There are two distinct seasons in the study area; the rainy season and the dry season. The rainy season commences between April and June. The length of the rainy season varies from 90 days to 200 days. The dry season extends from October to early June and is marked by hot dry north eastern harmattan winds.

The lowest mean temperature is usually recorded during the harmattan period. This occurs between November and February with the range from 18°C – 23°C.

Kudan is a Local Government Area in Kaduna State, Nigeria. The area has an area of 400km² and a population of 138, 992 at the 2006 census 167906 with a projected population of 357085 people in 2014 at a population growth rate of 3.2 per cent. The major source of livelihood in this area is agriculture and the bulk of agricultural production is undertaken by small farmers. The major crops grown in the area are maize, cowpea, potatoes, tomatoes, pepper, onions, wheat, lettuce, carrot, garden eggplant, amaranthus and sugarcane.

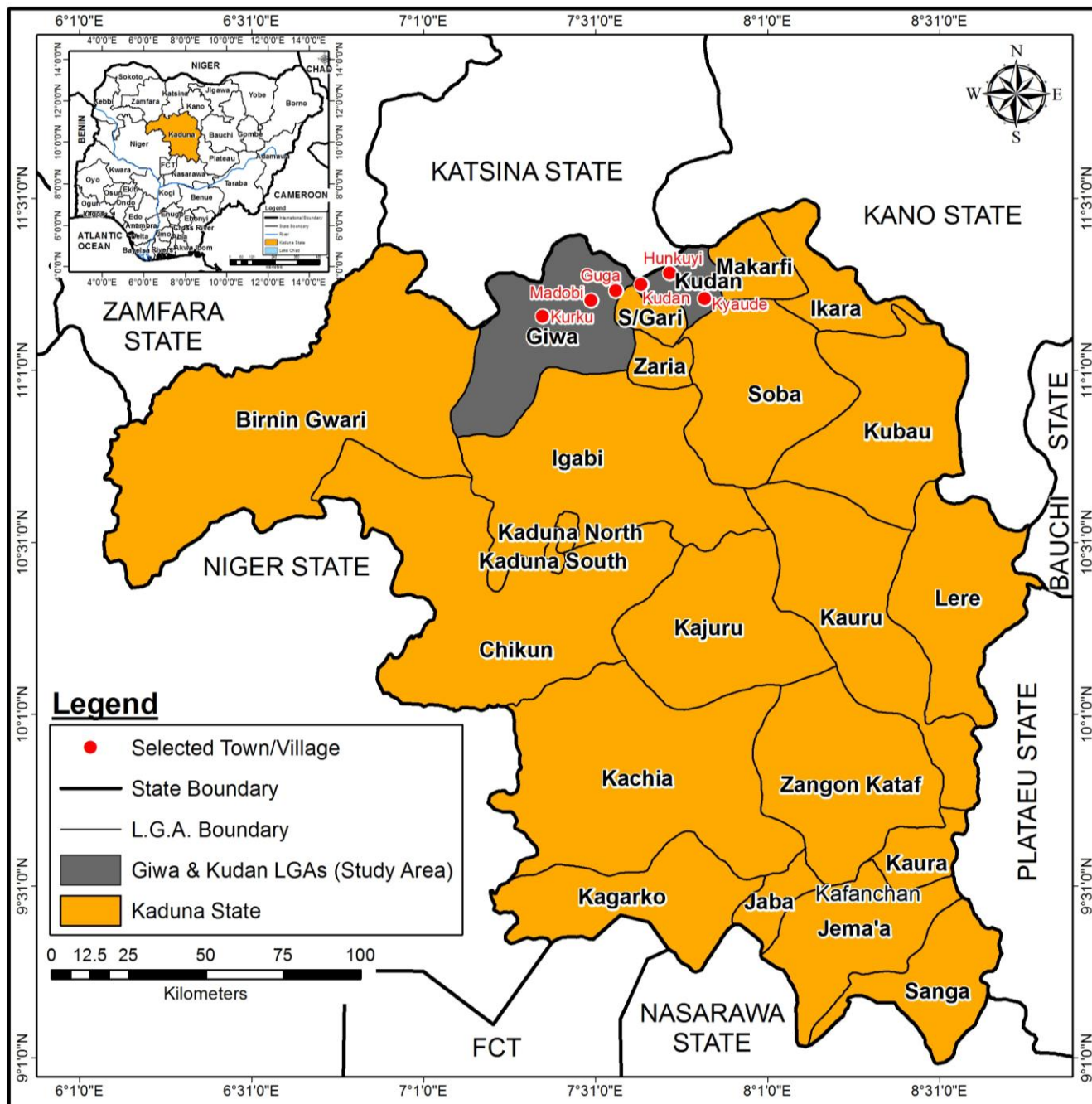


Figure 3.1: Map of Kaduna State showing the Study Area

3.2 Sampling technique and Sample Size

A multi-stage sampling technique was used for this study. The first stage was the purposive selection of two (2) Local Governments Areas, these are Giwa and Kudan based on the predominance of Irish potato production activities among the farmers. Secondly, six villages were purposively selected, three from each LGA , These are Guga, Madobi and Kurku while the villages selected from Kudan are Hunkuyi, Kyaude and Kudan based on their intensity of Irish potato production. Finally, a simple random sampling was employed in selecting the respondents who are adopters of recommended Irish potato production practice and those who are non-adopters. The selection of these respondents was assisted by the list of Irish potato farmers given by the Kaduna State agricultural development project (Table 1). One hundred and eighty two (182) questionnaires were administered, ninety three (93) for adopters while eighty nine (89) for non-adopters, only eighty (80) questionnaires each for adopters and non-adopters was correctly filled and returned, making a total of one hundred and sixty (160) questionnaires. Analysis was based on one hundred and sixty (160) questionnaires.

Table 3.1: Distribution of respondents in the study area

L.G.A	Villages selected	Population	Adopters	Sample size (10%)	Non-adopters	Sample size (10%)
Giwa	Guga	520	279	28	241	24
	Madobi	348	151	15	197	20
	Kurku	216	117	12	99	10
Kudan	Hunkuyi	309	155	16	154	15
	Kyande	183	97	10	86	9
	Kudan	224	117	12	107	11
Total		1800	916	93	884	89

3.3 Data Collection

Primary data were used in the study. The primary data were collected through the use of pretested and validated questionnaire administered to both adopters and non- adopters of recommended Irish potato production practices by well-trained enumerators. The information collected includes socio-economic, institutional and technological characteristics of the respondents, adoption of recommended Irish potato recommended practices and constraints to the adoption of Irish potato recommended practices. Other data collected include level of adoption of recommended Irish potato production practices, yield and income.

3.4 Analytical Tools

3.4.1 Descriptive statistics

This was used to achieve objective i, ii, and vi of the study. This involved the measures of central tendency such as mean, frequency distribution and percentages.

3.4.2 Multiple regression analysis

This was used to achieve objective iv that is factors influencing the adoption of recommended Irish potato production practices and to test hypothesis i. The recommended Irish potato production practices adopted for this study were: planting material, planting date, method of planting, planting depth, planting space, fertilizer application, weeding and harvesting. The regression analysis is useful in estimating the contributions of each variable to the dependent variable to determine the best variable predictive of adoption by farmers and effects (Olayide and Heady, 1982). Agwu *et al.* (2008) applied the number of technologies adopted by a farmer as dependent variable (Y). This study applied the number of recommended Irish potato production practices adopted by a farmer as dependent variable (Y). The number of recommended Irish potato production practices adopted by the farmer was used as proxy for the adoption which is the dependent variable Y.

The model is specified below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{13} X_{13} + e.$$

Where:

Y= dependent variable as defined above i.e. Adoption (number of recommended practice adopted by a farmer)

X_1 = Farmers' age (years)

X_2 = Marital status (single = 1, married = 0)

X_3 = Level of education (Number of years in formal schooling)

X₄ = Household size (number in household)

X₅ = Farm size (hectares)

X₆ = Farming experience (years in Irish potato production)

X₇ = Access to credit (actual amount received ~~€~~)

X₈ = Information source (number of sources used)

X₉ = Membership of association (years of membership of co-operative associations)

X₁₀ = Extension contact (number of visits)

X₁₁ = Relative advantage index (relative advantage=1, not relative advantage=0)

X₁₂ = Compatibility index: (compatible=1 not compatible=0)

X₁₃ = Complexity index: (not complex=1, complex=0)

b₁ – b₁₃ = Régression coefficients

a = constant

e = error term

3.4.3 Z-Statistic

This was used to achieve objective v and to test hypothesis ii of the study. This is to compare the differences in yield and income of adopters and non- adopters of recommended practices.

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where Z = calculated Z value

\bar{X}_1 = Mean yield and mean income of adopters of recommended practices

\bar{X}_2 = Mean yield and mean income of non-adopters of recommended practices.

S₁= Standard deviation of adopters.

S₂ = Standard deviation of non-adopters.

n_1 = Sample size of adopters.

n_2 = Sample size of non- adopters.

3.5 Operational Definitions and Measurement Variables

3.5.1 Independent Variables

These are also called predictor variables and those that will be used in this study were age, marital status, level of education, farm size, family size, farming experience accessibility to credit and information sources. Others were membership of association, extension contact and accessibility to technology. It is expected that these variables will exert influence on the adoption of the chosen technologies.

i. Socio-economic Characteristics

- a. **Age:** The ability to learn fast and decide on certain key issues and act favourably to certain information depends on age of the individual. Young people understand faster than old people but older people have better ways of perception and think deeply before acting. Melaku, (2005) and Kidane, (2001) indicated experience on farm activities has a positive and significant relation with adoption. On the other hand, older household heads are more reluctant to adopt new technologies and innovations which can improve their potential. Age of the respondent was measured by the actual years the individual has lived as given by him/her.
- b. **Marital status:** This is a condition or a state of being married or unmarried as indicated by the respondent. Marital status was expected to be positive and significantly related with adoption. Namwata *et al.* (2010) found that married household heads had more willingness to adopt improved technologies for Irish potato than the unmarried counterparts. This was measured by score. Married = 1, un-married = 0.

- c. **Level of Education:** This is the number of years a respondent has spent schooling. Education is not only an important determinant of knowledge of an innovation but also an instrument for correct use of innovation for profitability. Education basically equips individuals with the necessary knowledge as to how to allocate their scarce resources to achieve optimal output and accordingly is positively associated with adoption. Mwanga *et al.* (1998) carried out a study in Tanzania and found that education level significantly affected the adoption of improved wheat varieties. Similarly, Studies carried out by Asfaw *et al.* (1997), and Tesfaye and Alemu (2001), indicated positive relationship between education and adoption. Level of education was measured in terms of the number of years of formal schooling.
- d. **Size of household:** the size of household is an important factor in traditional agriculture because it influences to a large extent the supply of labour for immediate farm employment (Akinyemi, 1998). Farm households with a larger pool of labour are expected to adopt new varieties and use it more intensively because they have labour shortages at peak times. Household size is associated positively with adoption. Arellanes, (2003) reported a significant positive relationship between family labor supply and adoption. Techane, (2002) concluded that family labor was positively related with adoption and intensity of fertilizer use. This was measured based on the number of people in a household.
- e. **Farm size:** It is associated with greater wealth. It will increase farmers' production thereby enhancing market oriented production. In order to be market oriented, however, the farmers need to first adopt new more productive Irish potato varieties. A study carried out by Mwanga *et al.* (1998) in Tanzania has indicated that farm

size level significantly affected the adoption of improved wheat varieties. Many others, Tesfaye and Alemu (2001), Mulugeta (2000), Million and Belay (2004) and Taha (2007), also reported positive relationship of farm size with adoption. It is given as estimated total area of land in hectares cultivated by a respondent.

- f. **Farming experience:** This refers to the number of years that a respondent has actively involved in farming operation. Age of the farmer is, therefore, the best proxy variable for farming experience implying that older household heads may have a better productive practices than the younger ones making their counter parts less efficient. Different studies confirmed this position. Melaku, (2005) and Kidane, (2001) indicated experience on farm activities has a positive and significant relation with adoption. This was measured in years.

ii. Institutional characteristics

- g. **Access to credit:** This is the access to formal sources of credit by Irish potato farmers for the purpose of farming. According to Abe (1981), agricultural credit covers all loan and advances granted to farmers to finance and serve other production activities related to agriculture. This is the amount of money borrowed by the respondent for the purpose of Irish potato production in 2014. Credit is therefore required to finance these incidental expenses. This was measured in Naira amount of credit obtained. It is therefore, postulated that amount of credit received would be positively influence the adoption of recommended Irish potato production practice.
- h. **Information sources:** These are the various sources through which the respondents received information about recommended Irish potato production practices. The source where a farmer can obtain knowledge about activities and the service it

provides is important in adoption process. The source of information could be through radio, television, extension publications, newspapers and journals. This was measured by the total number of information sources the respondents used.

- i. **Membership of associations:** Membership to farmer groups is basically related to social participation. Ebrahim, (2006) social participation contributed positively to the adoption of dairy technologies. Similarly, Dereje, (2006) reported that social participation had significant and positive relationship with adoption. In this study, it was measured by the total number of years the respondent claimed to have belonged to associations as at the time the study was conducted.
- j. **Extension contact:** This is the frequency of visits by extension workers to the farmer. Extension on adoption of recommended practices represents access to the information required to make the decision to adopt. Namwata *et al.* (2010) indicated that household heads who had access to extension services were more likely to adopt improved technologies for Irish potato than the ones who do not. Other authors, Chilot *et al.* (1996) and Tesfaye and Alemu, (2001), also found significant relationship of access to extension to adoption of agricultural technologies. This was measured by the number of extension

iii. Technological Attributes

- k. **Relative advantage:** This refers to the degree to which the recommended for Irish potato production practice is seen as superior to the one it is meant to replace. This was measured using five point score as strongly agree = 5, agree = 4, undecided = 3, disagree = 2 and strongly disagree = 1. It was assumed that recommended Irish potato production practice that had relative advantage would have a positive sign. Because practices that had relative advantage to the existing practices would be more

highly adopted than those that are relative disadvantage. The weighted mean score was computed. Mean scores cut-off points of 3.0 or above was classified as relative advantage was assigned 1; while mean scores cut-off less than 3.0 was classified as relative disadvantage was assigned 0.

l. **Compatibility:** This is the degree to which recommended practice is perceived as consistence with the existing values, past experience and needs of the farmers. A recommended practice that is compatible was adopted more rapidly than the one that is incompatible. This was measured using five point score as strongly agree = 5, agree = 4, undecided = 3, disagree = 2 and strongly disagree = 1. It was assumed that compatibility would have a positive sign. Because recommended practice that are compatible with the existing practices would be more highly adopted than those that are incompatible. The weighted mean score was computed. Mean scores cut-off points of 3.0 or above was classified as compatible was assigned 1; while mean scores cut-off less than 3.0 was classified as not compatible was assigned 0.

m. **Complexity:** It is the degree to which a recommended practice is perceived as difficult to understand and use. Some technologies are easily understand by farmers while others are more completed. A recommended practice that is easy to understand would tend to be more readily adopted than the complex ones. This was measured using five point score as strongly agree = 5, agree = 4, undecided = 3, disagree = 2 and strongly disagree = 1. It was assumed that complex recommended practice would have negative sign because complex recommended practice would not be readily adopted than simple ones. The weighted mean score was computed. Mean scores cut-off points of 3.0 or above was classified as not complex was assigned 1; while mean scores cut-off less than 3.0 was classified as complex was assigned 0.

3.5.2 Dependent Variable (Y)

a. Adoption: It is regarded as decision of a farmer to make use of recommended Irish potato production practices on continuous and large scale basis (Rogers, 1995). In this study, adoption refers to the use of recommended Irish potato production practices which constitutes the dependent variable. Agwu *et al.* (2008) applied the number of technologies adopted by a farmer as dependent variable (Y). This study applied the number of recommended Irish potato production practices adopted by a farmer as dependent variable (Y). A respondent scores two for each component of Irish potato recommended practice adopted. The recommended rates used in the study areas for production of Irish potato are as follows:

-Planting material: The following are the improved varieties used in the study area, Ajax (for rainy season), Romanoc and RC767-2 (for rainy and dry seasons).

-Planting date: Plant as early as the rains are steady (May to early June).

-Method of planting: Make ridges of 15-30cm (6inches -12inches) high, spaced 2ft (60 cm) apart. Plant sprouted big-size healthy tubers spaced at 30cm in rows, 5-7.5cm deep for big size tubers and small size tubers for smaller size tuber yield. In case of single rows, leave 2ft (60cm) cm to 3 ft (90cm) apart and incase of double rows leave a space of 6ft (180 cm) to the next row.

-Planting space: Plant on ridges 75-90cm apart and 30cm between stands at one plant per stand.

-Fertilizer application: Use NPK Fertilizer 20:10:10 at the rate of 8bags plus 2bags of SSP or 8bags of SSP+ 3.5bags of Urea per ha applied at spouting.

-Weeding: 1st weeding should be done at 3WAS and moulding of the ridges 4 weeks later for good tuber formation. The farmer may use the following herbicides:

- Sencor 50WP at 0.9kg in 300Litres of water/ha
- Enide 50WP at 1.10kg in 300Litres of water/ha, all applied pre-emergence.

-Harvesting: Harvest when the leaves turn yellow through mechanical (harvesters)

b. Level of adoption: This is the extent to which the Irish potato farmer has accepted or is pleased with each of these seven extension services provided viz: planting material, planting time, planting depth, planting space, fertilizer application, weeding and harvesting. Adoption level of 1-3 for low, 4-6 for moderate and 7 and above for adopters (Nmadu *et al.*, 2014) was adopted for this study. Possible maximum and minimum scores for each respondent were 7 and 1 respectively.

c. Effect:

- Increased Yield:** In this study, yield is referred to as the output per unit area of production. Yield was measured in kg/ha.
- Farm Income:** It is referred to as the total amount of money accruable to the farmer from the sales of Irish potato within the period of the study. Farm income was measured in Naira/annum. (₦).
- Level of Living:** Is the level of material comfort enjoyed by farmers as a result of adopting recommended Irish potato production practices. According to Ekong (2003), level of living is generally used to describe the quantity and quality of goods and services consumed by an individual and his household members and also the possession of material things. Study have shown that level of living is the sustainable access to resources to meet basic need such as adequate food supply, portable drinking

water, good health care facilities, educational opportunities, housing and leisure time for individual participation in social functions. Level of living was measured by ownership of material things such; Cars, Buses/pickups, Motorcycles, Bicycles, Grindings Machines, Farm equipment, livestock and House utensils possession bought with money and adopted technology. It was measured by the ownership and usage of assets possessed by the farmer and was computed in a monetary value for an individual farmer to determine his/ her livelihood.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Irish Potato Farmers in the Study Area

In this section the general socio-economic characteristics of Adopters and Non-adopters of recommended Irish potato production practice is provided. These include gender, age, household size, educational level, farming experience, cooperative societies, amount of credit and farm size for Irish potato as shown in Table 4.1.

4.1.1 Age distribution

The study reveals that majority (78%) of adopters were between the ages of 24 - 45 years with mean age of 43 years, while approximately 70% of non-adopters were between the ages of 24 - 45 years with mean age of 42 years, indicating that most of the respondents were of the middle age, the age at which they were still energetic and hence can actively involve in production activities (Lupilya, 2007). This finding disagrees with the findings of Pur, Ibrahim; and Sabo (2007) and Nwakor *et al.* (2008) that the level of youth involvement in agriculture have reduced due to schooling and part-time farming.

4.1.2 Gender distribution

The study reveals that 94% of adopters were male, while 6% were female, while approximately 89% of non-adopters were male while 11% were female. The low percentage of the female participating in Irish potato production could be attributed to the fact that females in the study area usually involved in several other activities outside farming like food vendors, hair dressing, tailoring and petty trading, this will in turn affect their adoption of the recommendation practices. This is in line with World Bank

(1999) which states that most women find it difficult to cope with labour intensive works as compared to men counterparts.

4.1.3 Household size

The result revealed that majority (91%) of adopters had household size between 1-18 people with mean household size of approximately 10 people while approximately 91% of non-adopters had household size between 1-18 people with mean household size of approximately 8 people. There is no much differences between the household size of adopters and non-adopters in the study area. It therefore means that the farmers had a fairly large household which could probably serve as an insurance against short falls in supply of farm labour. Household size has a great role to play in family labour provision in the agricultural sector (Sule *et al.*, 2002).

4.1.4 Educational level

It was found that 33% of adopters had no formal education, approximately 16%, 17%, 12% and 2% had primary, secondary, diploma/NCE and degree, respectively, while 36% of non-adopters had no formal education, approximately 15%, 23% and 4% had primary, secondary, diploma/NCE and degree, respectively. This indicates that approximately 59% of adopters and 65% of non-adopters had some form of educational level of qualifications. The implication of education in agricultural production according to Arnon (1987), is that education is an important socio-economic variable and a form of human capital for agricultural development. Similarly, Ogunbameru (2001) noted that education would likely enhance the adoption of modern farm technologies by youth and thereby sustaining a virile farming population. Ojukaiye (2001), posited that education is an important socio-economic factor that influences a farmer's decision because of its influence on the farmer's awareness, perception,

reception and the adoption of innovation that can bring about increase in production. Since a high percentage of the youths were educated, their education was expected to enhance adoption of recommended cassava production practices in the study area.

4.1.5 Farming experience

It was found that majority 70% of adopters had between 4-21 years of experience with mean farming experience of 17 years, while approximately 78% of non-adopters had between 4-21 years of experience with mean farming experience of 14 years. There is no much differences between the years of experience in Irish potato farming between the adopters and non-adopters in the study area. Farming experience is used as a measure of management ability, the more experience the farmer is, the more his ability to make farm decision. This result showed that most of the respondents had long years of farming experience, implying that such farmers are likely to make decisions that would increase their output and income.

4.1.6 Cooperative societies

Membership of cooperatives influences adoption of improved technologies resulting in higher productivity and poverty alleviation (Amaza *et al.*, 2009). It was found that majority 94% of adopters belonged to cooperative societies with less than 6 years of membership. The average years of membership of cooperative society is 6 year, while approximately 95% of non-adopters belonged to cooperative societies with less than 6 years of membership. The average years of membership of cooperative society is 4 year. The effect of this result is that most of the Irish farmers in the study area enjoy the benefits accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit maximization. This finding is in line with Odebiyi (2010) that cooperative groups

ensure that their members derive benefits from the groups such as they could not derive individually.

4.1.7 Amount of credit obtained by Irish farmers

Adequate funding is required by farmers to finance all Irish production and marketing activities. It was found that majority 98% of adopters had access to credit ranges between ₦10,000 -₦100,000 with mean amount of ₦33587.5, while approximately 95% of non-adopters had access to credit ranges between ₦10,000 -₦100,000 with mean amount of ₦25125.00. However, Ekong (2003) asserts that credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. According to Tijani *et al.* (2006), access to credit provides the farmer with a means of expanding and improving his farm. It also determines the ease with which he adopts new practices and technologies in his enterprise. The study by Wozniak (1993) supported this fact by reporting in his study that credit increases the net revenue obtained from fixed inputs, market conditions and individual characteristics, while credit constraint decreases the efficiency of farmers by limiting the adoption of high yielding varieties and the acquisition of information needed for increased productivity.

4.1.8 Farm size

The size of the farm cultivated is a function of population pressure, family size and financial background of the farmers. One major characteristic of small-scale farmers is fragmented land holding. Majority (65%) of adopters cultivate farm lands of 1.0 to 4.9 hectares, while, approximately 24% cultivate farm lands of above 6.0 hectares with mean farm land of 4 hectares, approximately 85% of non-adopters cultivate farm lands of 1.0 to 4.9 hectares, while, approximately 11% cultivate farm lands of above 6.0

hectares with mean farm land of 3 hectares. Going by Ojuekaiye (2001), classification of farm size of 0.1 hectare to 5.9 hectares as small farms, it then implies that majority of the respondents were small-scale farmers. This will not allow for meaningful investment and returns to scale on food security.

Table 4.1: Socio-economic characteristics of Irish potato farmers in the study area

Characteristics	Adopters		Non-adopters	
	Frequency	Percentage	Frequency	Percentage
Age				
24-34	28	35	24	30
35-45	34	43	32	40
46-56	13	16	18	23
57-67	3	4	5	6
68 and Above	2	3	1	1
Mean	43		42	
Gender				
Male	75	94	71	89
Female	5	6	9	11
Household size				
1-9	41	51	53	66
10-18	32	40	20	25
19-27	5	6	6	8
28-36	2	3	1	1
Mean	10		8	
Educational level				
Non-formal	33	41	29	36
Primary	16	20	12	15
Secondary	17	21	18	23
Diploma/NCE	12	15	18	23
Degree	2	3	3	4
Farming experience				
4-12	32	40	47	59
13-21	19	24	15	19
22-30	24	30	14	18
31-39	4	5	3	4
40-48	1	1	1	1
Mean	17		14	
Cooperative societies				
<6	75	94	74	93
7-13	5	6	6	8
14-20	0	0	0	0
Mean	6		4	
Amount of credit				
10000-100000	78	98	76	95
101000-191000	0	0	0	0
192000-282000	1	1	3	4
283000-373000	1	1	1	1
Mean	33587.5		25125	
Farm size for Irish potato				
1.0-1.9	8	10	16	20
2.0-2.9	3	4	15	19
3.0-3.9	12	15	33	41
4.0-4.9	29	36	4	5
5.0-5.9	9	11	3	4
6.0 and above	19	24	9	11
Mean	4		3	
Total	80	100	80	100

4.2 Sources of Information about Recommended Irish Potato Production Practices

The sources of information on recommended Irish potato production practices available to farmers included extension worker, village/community leaders, co-farmers/friends, research institutions, traders and others such as radio, television and print media. It was found that most of the respondents 31% acquired information about recommended Irish potato production practices through extension worker, approximately 13 % through co-farmers and research institutes, 11% village/community leaders and traders, finally 20% acquired information through other sources such as radio, television and print media. The efficiency of extension organizations providing information to Irish potato farmers on improved Irish potato production practices will play a significant role in the level of farmers' innovation uptake with respect to Irish potato production. This finding is in tandem with Adeogun *et al.* (2009), they reported that the efficiency of extension organizations providing information to cocoa farmers on improved cocoa technologies will play a significant role in the level of farmers' innovation uptake with respect to cocoa production.

Table 4.2: Distribution of respondents according to their source of information about recommended Irish potato production practices

Sources of information	Frequency	Percentage
Extension Worker	127	31
Village/Community Leaders	47	11
Co-Farmers/Friends	55	13
Research Institutions	56	13
Traders	46	11
Others	84	20
Total	415*	100
Multiple Response Allowed*		

4.3 Level of Adoption of Recommended Irish Potato Production Practices

The complementary recommended Irish potato production practices include fertilizer application, planting time, method of planting, planting depth, planting space, weeding and harvesting. These components of recommended Irish potato production practices were adopted by the farmers in varying degrees. Adoption in this study was based on the number of technologies constantly used by the respondents. The adoption level represents the number of respondents using the practices as a percentage of the total number of the respondents studied (Ojo, 2009). It was found that 15% of the respondents adopted planting material, while 16% adopted planting time, approximately 12% adopted weeding time while 11% adopted plant depth and harvesting techniques, also 10% and 9% of the respondents adopted method of planting and planting space, respectively. Finally, approximately 17% adopted fertilizer application. Fertilizer application has the highest adoption (17%) level. This can be seen as evident in the yield. This agrees with Ikechukwu (1990), who reported 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.

Planting space recorded the least of adoption among the respondents (9%), weeding time and planting depth recorded 12% and 11% of adoption, respectively. These could be attributed to old management techniques employed by the farmers to control pest infestation and therefore does not deviate from the practices that rural youth have known. Method of planting recorded 10% of adoption. This could be attributed to the fact that Irish potato farmers in the study area still use the traditional method of planting.

Table 4.3: Distribution of Irish potato farmers according to adoption of recommended practices

Recommended practices	Frequency	Percentage
Planting material	93	15
Planting time	97	16
Method of planting	64	10
Planting depth	70	11
Planting space	55	9
Fertilizer application	105	17
Weeding	75	12
Harvesting	72	11
Total	631*	100

Multiple Response Allowed*

The results in Table 4.3.1 shows that 68% of Irish potato farmers adopted the recommended practices moderately which were 1-3, about 20% had low level of adoption of 4-6 while, about 13% had high adoption level of 7 and above with a mean adoption level of 4 which fall within the moderate level of adoption. The finding is at variance with Yahaya and Olayide (2006) claim that cassava farmers in Nigeria level of awareness of associated technologies was high. In spite of the rigorous efforts of the extension agents towards dissemination of the recommended practices, farmers' level of adoption was observed to be at the moderate level. This is a pointer to the need to arouse the interest of the farmers through combination of several teaching methods that can be useful when interacting with farmers. This is in line with Cees (2004), who submitted that result demonstrations are useful for raising awareness which eventual leads to adoption.

Table 4.3.1: Distribution of Irish potato farmers according to level of adoption of recommended practices

Score	Frequency	Percentage	Level of adoption
1-3	32	20	Low
4-6	108	68	Moderate
7 and above	20	13	High
Total	160	100	
Max	7		
Min	1		
Mean	3.54		
Std. Dev.	1.97		

4.4 Socio-Economic, Institutional and Technological Factors influencing Adoption of Recommended Irish Potato Production Practices

Socio-economic, institutional and technological factors influencing adoption of recommended Irish potato production practices are presented in Table 4.4. The adjusted R^2 value was found to be 0.599, implying that the independent variables explained 59.9% of the variations in the dependent variable. The result revealed that of the thirteen (13) variables included in the regression model age, household size, farm size, farming experience, access to credit, information source, membership of association, relative advantage and compatibility index were the factors that significantly influence the adoption of recommended Irish potato production practice. The fitness of the model was further confirmed by the low value of the standard error of the estimate (Standard Error = 0.214). Again, the overall significance of the model was depicted by the F-statistics which was significant at 1% level of significance. The significance of F-ratio shows that the regression result was statistically reliable.

Coefficient for age was found to be negative and statistically significant at 5% level of significance. This implies that the older farmers adopt less of the recommended Irish potato production practices. Conversely, the younger farmers adopt new innovations more than the older farmers probably because they are more adventurous than their older counterparts. This is in tandem with the earlier finding that Irish potato farmers in the study area were more of young people rather than elderly who are 24-45 years, and still very active.

The coefficient of household sizes was found to be positive and statistically significant at 5% level of significance. This means that as the household size increases, adoption of recommended Irish potato production practices also increase. This confirm with earlier studies that farmers were youth and youth have relatively smaller families compared to older farmers and this leads them to take more risk (of adopting new practices) than the older farmers. This agrees with Adesope (2006), who opined that youth are less conservative in their nature and are more receptive to change.

The coefficient of farm size was found to be positive and statistically significant at 10% level of significance. This means that as the farm size increases, adoption of recommended Irish potato production practices also increase. Farm size has bearing on the capacity of farmers to adopt improved technologies and new farm practices. Farmers with large farm size can afford to devote part of their farms for soybean production without significantly affecting the total land left for the production of the staple food crops compared to small land holders. Land size is also one of the indicators of the level of economic resources available to farmers (Ajibefun, 2006).

The coefficient of farming experience was found to be positive and statistically significant at 10% level of significance. This means that the more their farming experience, the higher the probability of adoption of the recommended Irish potato production practices. Farming experience is an important determinant of the respondent's level of farm income. Farming involve a lot of risks and uncertainties, therefore to be competent enough to handle all the vagaries of agriculture farmers must have stayed in farming business for quite some time (Ogundele and Okoruwa, 2006).

The coefficient of access to credit was found to be positive and statistically significant at 10% level of significance. This suggests that farmers who received credit adopted more of the recommended Irish potato production practices than those who did not thus implying that availability of credit enhances adoption of recommended Irish potato production practices. This is as expected because availability of credit enhances farmer's ability to purchase the inputs embodied in a new practices and also pay for hired labour needed for the use of these inputs and improved management practices. This corroborates with the earlier findings that 96% accessed credit of between ₦10000-100000 (Table 2).

The coefficient of information sources was found to be negative and statistically significant at 10% level of significance. This implies that information sources had an inverse relationship with the adoption of recommended Irish potato production practices. This result is confirmed by the earlier result which revealed that agricultural extension workers constituted 31% of information source (Table 3), which reach only a smaller number of people per message over smaller spatial range. Though information create awareness and educate the farmers on application of practices, consequences of wrong applications and the effect of timely applications.

Such technical information are very useful during the trial stage of adoption process and are capable of leading to adoption of agricultural innovations.

The coefficient of membership of association was found to be positive and statistically significant at 5% level of significance. This implies that farmers who are members of cooperative association adopted more of the recommended practices than non-members. Cooperative association enhances access to information on recommended practices, material inputs of the practices such as fertilizers and credit for the purchase of inputs and payment of hired labour. This finding is in consistent with the study of Deji (2005), who found membership of cooperative societies as a predictive factor of adoption behaviour of farmers.

The coefficient of relative advantage index was found to be negative and statistically significant at 1% levels for the recommended practices showing that the compatibility of the innovation increase the adoption of the innovation when the practices. This implies that the recommended Irish potato production practices introduced is more superior to the old practices.

The coefficient of Compatibility index was found to be negative and statistically significant at 1% levels for the recommended practices showing that the compatibility of the innovation increase the adoption of the innovation when the practices is similar and agreed with the existing culture it will hasten the adoption of such recommended practices. This agreed with Rogers (1995) that there are characteristics of the farmers that affect their rate of adoption such as compatibility and complexity of the technology.

Test of hypothesis i

The null hypothesis stated that there is no significant relationship between farmer's socio-economic characteristics, institutional factors and adoption of recommended Irish potato production practices. The result of the regression analysis in Table 4.4, revealed that socio-economic characteristics such as; age, household size, farm size, farming experience, access to credit, information sources and membership of association were significantly related with adoption of recommended Irish potato production practices at various level of significance. Based on this result, the null hypothesis was therefore rejected as there was significant influence between farmer's socio-economic characteristics, institutional factors and adoption of recommended Irish potato production practices.

Table 4.4: Result of socio-economic, institutional and technological factors influencing adoption of recommended Irish potato production practices

Variable	Coefficients	Standard Error	T- Stat
Constant	51.8527	18.36606	2.823289
Age	-0.50254**	0.250441	-2.00663
Marital status	-4.76668	6.496902	-0.73368
Education	-1.34593	1.986597	-0.67751
Household size	3.361928**	1.487285	2.260447
Farm size	2.824124*	1.478473	1.910163
Farming experience	2.602498*	1.365755	1.905538
Access to credit	2.581688*	1.362451	1.894886
Information source	-2.5816*	1.362457	-1.89481
Membership of association	2.844925**	1.407784	2.020853
Extension contact	0.684345	0.768489	0.890508
Relative advantage index	1.436323***	0.234374	6.128326
Compatibility index	0.94377***	0.070728	13.34365
Complexity index	-0.01213	0.782945	-0.0155
R square	0.648775		
Adjusted R square	0.599694		
F-value	9.143***		
Standard error	0.214		

Note: *** Significant at 1%, ** Significant at 5% and * Significant at 10%

4.5 Effect of Adoption of Recommended Irish Potato Production Practices on Yield of Farmers

The result of the effect of adoption of recommended Irish potato production practices on yield of Non-adopters and Adopters of recommended Irish potato production practices is presented in Table 4.5. The values of mean yield for Non-adopters and Adopters were subjected to Z-test. From the result of the mean value of the yield of non-adopters is 779.1164kg/ha while 997.6104kg/ha for adopters of recommended practices. The difference between non-adopters and adopters mean yield is 218.49 kg/ha, while the calculated Z-value of 2.296 which is greater than the tabulated Z-value of 1.97 and statistically significant at 5% level of significance was obtained. A positive mean difference in yield value indicates positive impact of recommended Irish potato production practices on adopter yield (Nkonya *et al.*, 2008). This result is consistent with the findings of Ezech (2004) and Nkonya *et al.* (2008) who reported that Fadama project beneficiaries were better off than their non-beneficiary counter-part in terms of income and productivity.

Table 4.5: Effect of adoption of recommended Irish potato production practices on yield of Non- Adopters and Adopters

Variable	Yield(Kg/ha) Non-Adopters	Yield (Kg/ha) Adopters
Mean	779.1164	997.6104
Variance	2118006	2427848
Observations	80	80
Pooled Variance	2272927	
Hypothesized mean difference	0	
Df	158	
T-stat	2.29626**	
P(T<=T) one-tail	0.097913	
T Critical one-tail	1.649659	
P(T<=T) two-tail	0.0195826	
T Critical two-tail	1.967452	

Note: ** P<0.05

4.6 Effect of Adoption of Recommended Irish Potato Production Practices on Income of Farmers

The result of the effect of adoption of recommended Irish potato technologies on annual farm income of Non-adopters and Adopters of recommended Irish potato production practices is presented in Table 4.6. The values of mean annual farm income for Non-adopters and Adopters were subjected to Z-test. From the result of the mean value of the annual farm income of Non-adopter is ₦123368.6 while ₦178859.4 for Adopters of recommended practices. The difference between Non-adopters and Adopters mean annual farm income is ₦55490.8, while the calculated Z-value of 3.56285 which is greater than the tabulated Z-value of 1.97 and statistically significant at 1% level of significance was obtained. A positive mean difference in annual farm income value indicates positive impact of recommended Irish potato production practices on adopter's annual farm income (Nkonya *et al.*, 2008). This result is consistent with the findings of Ezech (2004) and Nkonya *et al.* (2008) who reported that Fadama project beneficiaries were better off than their non-beneficiary counter-part in terms of income and productivity.

Test of hypothesis ii

The null hypotheses stated that adoption of recommended Irish potato technologies has no significant impact on yield and income of Non-adopters and Adopters. Result from Table 4.5 and 4.6 indicates that the t-calculated is higher than the t-critical and statistically significant for both income and yield at 5% and 1% levels of significant, respectively. Based on this results, the null hypotheses which states that adoption of recommended Irish potato technologies has no significant influence on yield and income of Non-adopters and Adopters is rejected.

Table 4.6: Result of effect of adoption of recommended Irish potato technologies on annual farm income of Adopters and Non- Adopters

Variable	Annual farm Income(Naira) Non-Adopters	Annual farm Income(Naira) Adopters
Mean	123368.6	178859.4
Variance	1.11E+10	2.75E+10
Observations	80	80
Pooled Variance	1.93E+10	
Hypothesized mean difference	0	
Df	158	
T-stat	3.56285***	
P(T<=T) one-tail	0.000212	
T Critical one-tail	1.649675	
P(T<=T) two-tail	0.000423	
T Critical two-tail	1.967476	

Note: *** P<0.01

4.7 Constraints Faced by Farmers in the Adoption of Recommended Irish Potato Production Practices

The constraints faced by farmers in the adoption of recommended Irish potato production practices are presented in Table 4.7. It was found that about 24% of the farmers ranked insufficient capital as the major constraints. Credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. It agrees with findings of Nasiru, (2010) who noted that access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities. Approximately 16% and 14% of the farmers ranked pests and disease, inadequate storage as the second and third constraints, respectively. This finding agrees with Ugbajah and Uzuegbuna (2012) opined that pest and disease is responsible for causative factors of decline in cocoyam production in Ezeagu Local Government Area of Enugu State implications for sustainable food security. Also, approximately 13% of the farmers ranked poor information network as fourth constraints.

Finally, insufficient extension agent, lack of access road and high cost of farm inputs like seed, fertilizer and labour were ranked by 12%, 11% and 9% of the farmers as fifth, sixth and seventh constraints, respectively. According to the respondents, due to high cost of improved seed they make use of seeds from their previous harvest which is not reliable and can jeopardize improved and sustainable productivity. This finding is in line with Ekong (2003), opined that most farmers have little or no access to improved seeds and continues to recycle seeds that have become exhausted after generations of cultivation.

Table 4.7: Constraints faced by farmers in the adoption of recommended Irish potato production practices in the study area

Constraints	Frequency	Percentage	Rank
Insufficient capital	129	24	1 st
Pests and disease	88	16	2 nd
Inadequate storage	77	14	3 rd
Poor information network	69	13	4 th
Insufficient extension agent	66	12	5 th
Lack of access road	61	11	6 th
High cost of farm input	48	9	7 th
Total	538*	100	

Multiple Response Allowed*

CHAPTER FIVE

SUMMARY, CONCLUSIONS, CONTRIBUTION TO KNOWLEDGE AND RECOMMENDATIONS

5.1 Summary

This study focused on the factors influencing adoption of improved Irish potato production practices in Kudan and Giwa Local Government areas of Kaduna State, Nigeria. A two-stage sampling technique was used for this study. First stage, three villages were randomly selected from two Local Government Areas, in the second stage proportional sampling methods was used to select 160 Irish potato farmers for the study. The purpose of the study was to examine the factors influencing adoption of improved Irish potato production practices in kudan and giwa local government areas of kaduna State, Nigeria, and to achieve this, the study came up with six main objectives. These were to: describe the socio-economic characteristics of Irish potato farmers in the study area, examine the different sources of information through which farmers learn about recommended Irish potato production practices, assess the level of adoption of the recommended Irish potato technologies by farmers, determine the effect of socio-economic, institutional and technological factors on the adoption of recommended Irish potato production practices by farmers, examine the effect of adoption of recommended Irish potato production practices on income and yield of non-adopters and adopters of recommended Irish potato production practices and to describe the constraints faced by farmers in the adoption of recommended Irish potato production practices. Primary data were used for this study. A multi-stage sampling technique was used for this study. The first stage was the purposive selection of two (2) Local Governments Areas. Secondly, six villages were purposively selected, two from each LGA,

Finally, a simple random sampling was employed in selecting the respondents who are adopters of recommended Irish potato production practice and those who are non-adopters. Primary data were collected from 160 farmers through the use of random sampling techniques with the aid of structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, multiple regression analysis and Z-statistics.

The results of the socio-economic analysis shows that (63%) of adopters and 70% of non-adopters fall within the age range of 24-45years, majority (91%) of adopters and non-adopters had household size between 1-18 persons. Majority of Adopters (59%) and non-adopters (65%) had some form of formal educational qualifications. Approximately 70% of adopters and 78% of non-adopters have been cultivating Irish potato for 4-30 years, also (94%) of adopters and 93% of non-adopters were below 6 years of cooperative membership.

It was found that majority (31%) of the farmers acquired information about the recommended Irish potato production practices through extension services, while the least of the information sources were village/community leaders and traders which constitutes 11%.

It was found that about 68% of the respondents had moderate adoption level of 4-6 and above with a mean adoption level of 4 which fall within the moderate level of adoption. Farmers' level of adoption was observed to be at the moderate level.

The results of the multiple regression analysis revealed that age, household size, farm size, farming experience, access to credit, information sources, membership of association, relative advantage index, compatibility index and complexity index were

the socio-economics, institutional and technological factors that influence the adoption 65% of recommended Irish potato production practices by farmers in the study area.

From the result of Z-statistic it was found that the difference between the mean yield, mean annual farm income non-adopters and adopters of the recommended Irish potato production practices were 218.49 kg/ha and ₦55490.8 with statistically significant difference of 5 and 1% levels, respectively. Based on the results that the calculated Z-value of mean yield and mean annual farm income was greater than the tabulated Z-value, the null hypotheses were rejected.

Finally, insufficient capital was ranked as the foremost constraints faced by farmers in the adoption of recommended Irish potato production practices in the study area.

5.2 Conclusions

The study had shown that Irish potato farmers in the study area had adopted the use of recommended Irish potato production practices at different levels. It can be concluded that majority of the farmers acquired information about the recommended Irish potato production practices through extension services, with a mean adoption level of 4 which fall within the moderate level of adoption. Farmers' level of adoption was observed to be at the moderate level. Age, household size, farm size, farming experience, access to credit, information sources, membership of association, relative advantage index, compatibility index and complexity index were the socio-economics, institutional and technological factors that influence the adoption of recommended Irish potato production practices by farmers in the study area. Adoption of the recommended Irish potato production practices had increased the yield and income of the adopters. Finally, insufficient capital was ranked as the foremost constraints faced by farmers in the adoption of recommended Irish potato production practices in the study area.

5.3 Recommendations

Based on the findings, the following recommendations are made:

- i. Due to low level of adoption of recommended Irish potato production practices, it is recommended that extension agents should be well involved in disseminating these production practices by using open field days, demonstration and control plots so as to encourage farmers in adopting the production practices.
- ii. Government and other stakeholders need to also invest in extension service in sensitizing Irish potato farmers in the study areas of production practices as this have the potential to increase the level of adoption as well as farmer's productivity and income.
- iii. Most of the farmers mentioned inadequate capital as the foremost constraints in adoption of recommended Irish potato production practices. Since cooperative societies and banks cannot provide the entire needed fund for the production of Irish potato, farmers should be encouraged to diversify their livelihood activities by engaging in non-farming activities in order to augment farm family income and thereby increase productivity.
- iv. Poor information network was part of the constraint faced by Irish potato farmers in the study area. Farmers should form a production clusters to improve their market intelligence. This could be achieved through the formation of producer groups or cooperatives. In each group there should be an advisory committee trained in various aspects of marketing which will be able to have access to up-dated pricing information and make it available to farmers on time.

- v. The socio-economic, institutional and technological factors influencing the adoption of recommended Irish potato production practices in the study areas were age, farm size, farming experience, access to credit, information sources, membership of association, relative advantage and compatibility levels of significance.

5.4 Contributions to Knowledge

- i. The study revealed that 31% of the farmers acquired information about recommended Irish potato production practices through the extension services in the study area.
- ii. It was found that about 68% of the respondents had moderate adoption level of 4-6 and above with a mean adoption level of 4 which fall within the moderate level of adoption. Farmers' level of adoption was observed to be at the moderate level.
- iii. The socio-economic, institutional and technological factors that influence the adoption 65% of recommended Irish potato production practices in the study areas were: age, household size, farm size, farming experience, access to credit, information sources, membership of association, relative advantage and compatibility.
- iv. It was found that the difference between the mean yield, mean annual farm income of non-adopters and adopters of the recommended Irish potato production practices were 218.49 kg/ha and ₦55490.8 with statistically significant difference of 5 and 1% levels, respectively

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APPENDICE

RESERACH QUESTIONNAIRE

FACTORS INFLUENCING ADOPTION OF RECOMMENDED IRISH POTATO PRODUCTION PRACTICES BY FARMERS IN KUDAN AND GIWA LOCAL GOVERNMENT AREAS OF KADUNA STATE

Dear Respondent,

This questionnaire instrument is for research purpose only. All information given will be treated with high degree of confidentiality. You are therefore requested to answer the following questions as sincerely as possible.

Thank you.

(A) Background information on the questionnaire

- (i) Name.....
- (ii) Village.....
- (iii) Date of interview.....

Kindly tick (✓) or fill in the appropriate space(s) provided.

SOCIO-ECONOMIC VARIABLES

1. What is your age?..... year
2. Gender: Male () Female () 3. Marital status: (i) Single () (ii) Married ()
4. What is the number of people in your Household?
5. What is your highest level of formal education attained?
 - i No formal education []
 - ii Primary education []
 - iii Junior secondary education []
 - iv Senior secondary education []
 - v Diploma/NCE []
 - vi HND / Degree []
7. How long have you been in the farming business?.....
8. Do you engaged in other activities apart from farming? Yes [] No []

9. If yes indicate the activities
a. craftworks [] b. Trading [] c. Civil servant [] Others (specify) []
11. How did you acquire land for farming activities?
(i) Purchase ()
(ii) Rent ()
(iii) Leasehold ()
(iv) Gift ()
(v) Inheritance ()
(vi) Others, (specify):
12. What is the total size of your farm holding?.....ha
13. What is your total farm Size for Irish potato production? ha

INSTITUTIONAL VARIABLES

14. Do you have contact with extension agent(s) as regard recommended Irish potato production practices? Yes () No ()
15. If yes, give number of times a year?
16. Do you belong to any association? (i) Yes () (ii) No ()
17. If Yes, how many associations?.....
18. If Yes, how long?
19. Did you obtain credit/loan for Irish potato production?
(i) Yes () (ii) No ()
20. If yes, in what form did you received the credit/loan?
(i) Inform of cash []
(ii) Inform of input []
(iii) Others, (specify):
21. If cash, state the source and the amount received last year

Source	Amount (₦) and Year
Friends/family members	
Commercial banks	
Government ministry/parastatals	
Clubs/associations/cooperatives	
Agricultural Agencies	

Others, (specify):

22. If in input form. List the inputs used in kg or litre and their value in Naira (₦).

	Input (Kg or Litre)	Value (₦)
(i)
(ii)
(iii)
(iv)

23. If you have not received any creditor loan, state why?

- (i) No credit facilities ()
- (ii) I don't belong to any association ()
- (iii) Ignorance of the existence of bank loan ()
- (iv) Cumbersome of the procedures to obtain bank credit/loans()
- (v) Lack of collateral for bank credit/loans ()
- (vi) High interest rate ()
- (vii) Others, (specify):.....

25. Indicate from the following the source of your information about recommended Irish potato production practices?

- (i) Extension workers ()
- (ii) Village / Community leaders ()
- (iii) Co-farmers/friends ()
- (iv) Research Institutions ()
- (vi) Traders ()
- (vii) Others, (specify):

26. Identify the degree of reliability of the following sources of information.

MEDIA/AGENTS	1 Most Reliable	2 Reliable	3 Somewhat Reliable	4 Not Reliable
Extension Agent				
Printed Median				
Television				
Radio				
Research institute				
Friends/neighbors/Co-farmers				
Village heads/opinion leaders				

Others, (specify).....

TECHNOLOGICAL VARIABLES

27. Have you received any formal training on recommended irish potato production practices?

(i) Yes () (ii) No ()

28. If Yes, list the benefits you received from the training exercise.

(i).....

(ii).....

(iii).....

(iv).....

29. If yes, which of these recommended irish potato production practices have you been trained on?

i Planting material (Healthy tubers 4000/ha) []

ii planting time (October-November)[]

iii Method of planting []

iv Planting depth []

v Planting spacing []

vi Fertilizer application []

vii Weeding []

viii Harvesting []

30. Which of these recommended production practices do you use? Please tick from the list.

- i Planting material []
- ii planting time []
- iii Method of planting []
- iv Planting depth []
- v Planting spacing []
- vi Fertilizer application []
- vii Weeding []
- viii Harvesting []

31. For how long have you been using the recommended Irish potato production practices? _____ Years.

32. Please state your opinion about the relative advantage of recommended Irish potato production practices? Please tick from the following list using:

- SA = Strongly Agreed
- A = Agreed
- UD = Undecided
- D = Disagreed
- SD = Strongly Disagreed

(A) Relative Advantage		5 SA	4 A	3 UD	2 D	1 SD
I	The recommended Irish potato technologies have higher yield than the old ones					
ii.	The recommended Irish potato technologies provide higher income than the old ones.					
iii.	The recommended Irish potato technologies are cheap / economical to adopt.					
iv.	The skill required to use the recommended Irish potato technologies can be easily acquired.					
v.	The recommended Irish potato technologies require less labour.					
vi.	The recommended Irish potato technologies make use of less inputs to give the same output as the old practices					
vii.	The recommended Irish potato technologies stem cuttings mature earlier than the old cultivars.					
viii.	The recommended stem cuttings are resistance to pests and disease infestations					

33. **Compatibility index**

(B) Compatibility index		5	4	3	2	1
		SA	A	UD	D	SD
I	The recommended Irish potato technologies are similar to the existing practices.					
ii.	The innovation meets my needs					
iii.	The recommended Irish potato technologies give me satisfaction.					
iv.	The recommended Irish potato technologies fit well into the existing farming systems					

34. **Complexity index**

(C) Complexity index		5	4	3	2	1
		SA	A	UD	D	SD
I	It is difficult to use the recommended Irish potato technologies correctly.					
ii.	The level of skill required to use the recommended Irish potato technologies is too high.					
iii.	The recommended Irish potato technologies are too technical.					
iv.	Training is required to correctly apply the recommended Irish potato technologies.					

ADOPTION

34. Did you adopt the recommended Irish potato production practices introduced?

Yes [] No []

35. If no, give reasons why.....

36. If yes, which of these recommended Irish potato production practices have you adopted?

Recommended Irish potato Production Practices	Yes	No
Planting material		
Planting time		
Method of planting		
Planting depth		
Planting spacing		
Fertilizer application:- (NPK 15:15:15: 4 - 6 bags per hectare depending on the fertility level of the soil)		
Weeding (chemical weed control) a. Pre-emergence herbicide: Alachlor (Lasso) at 300ml/CP15 knapsack sprayer. b. Selective post – emergence herbicide: Round–up at 4 – 5 litres per hectare.		
Harvesting – mechanical: (harvesters)		

37. What was your estimated yield of Irish potato tubers harvested in ton/ha from last year's cropping season

38. What was the estimated amount in naira (N) realized from the sales of harvested Irish potato from last year's cropping season?.....

IMPACT OF ADOPTION

39 Indicate the total number and current value of assets possessed as a result of adoption of recommended practices in Irish potato production

Assets	Number	Unit/price	Total value
Buildings			
Farm equipments			
Tractor			
Pumping machine			
Sprayer			
Vehicles/automobiles			
Car			
Lorry			
Motorcycle			
Others ((specified)			
Electricals			
Refrigerator			
Deep freezer			
Cooker			
Others (specified)			
Electronics			
Radio			
Video CD			
Rechargeable lamp			
Satellite dish			
Others (specified)			
Farm animals			
Cattle			
Sheep			
Goat			
Poultry			
Others (specified)			

PROBLEMS AND CONSTRAINTS

40. Are you faced with challenges/constraints in the adoption of recommended Irish potato production practices?

41. If yes, what are these constraints?

- i. Government policies on land use []
- ii. Scarcity of farm land []
- iii. Insufficient capital []
- iv. High cost of farm input []
- v. Processing, storage and marketing problems []
- vi. Insufficient extension agents []
- vii. Lack of access roads []
- viii. Problem of roots/tuber Pests and diseases []
- Ix Poor information network []

Others, (specify):

42. What will you suggest as the best way to improve the recommended Irish potato production practices in your village?

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

Thanks for your cooperation