IMPACT OF TUNGAN-KAWO DAM IRRIGATION PROJECT ON RICE PRODUCTION AND LIVELIHOOD OF SMALLHOLDER FARMERS IN WUSHISHI LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA

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

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SEPTEMBER, 2014

DECLARATION

I hereby declare that this thesis titled "**Impact of Tungan-Kawo Dam Irrigation Project on Rice Production and Livelihood of Small Holder Farmers in Wushishi Local Government Area, Niger 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 ideas have been duly acknowledged in the text and a list of references provided.

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CERTIFICATION

This thesis titled "**Impact of Tungan-Kawo Dam Irrigation Project on Rice Production and Livelihood of Small Holder Farmers in Wushishi Local Government Area, Niger State"** by Haruna Muhammad MAKUSIDI meets the regulations governing the award of degree of Master of Science of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

To my late parents and children.

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ABSTRACT

This study examines the impact of Tungan-Kawo dam irrigation project on rice production and livelihood of small holder farmers in Wushishi Local Government Area of Niger State, Nigeria. The specific objectives were to describe the socio-economic characteristics of small-holder rice farmers participating in Tungan-Kawo irrigation project; determine the level of adoption of recommended rice production practices by participants; assess the impact of Tungan-Kawo irrigation project on rice output, yield, income and level of living of the people; determine the socio-economic and institutional factors influencing the adoption of recommended rice production practices in Tungan-Kawo irrigation project and describe the constraints encountered by the participants and the management in the implementation of the project. Primary data were obtained by the use of structured questionnaire administered to 180 respondents comprising of 90 participants and 90 non-participants. Descriptive statistics, z-test statistic and multiple regression were used to analyse the data . Descriptive statistics was used for objectives 1, 2 and 3, the z-statistic was used for objective 3 to compare the differences in rice output, income and level of living between participants and non-participants. Multiple regression was used to analyse objective 4 of the study. The findings revealed that the average age of participants and non-participants was 44 years. About 98% of both participants and non-participants were male while only 2% participants were female. These results showed that the adoption of recommended rice production practices was very high in the study area. More than three quarter of the participants were married with average household size of 7 persons. The average rice production output of participants was estimated at1.175tons per annum while non-participants was 0.767 ton per annum . It was revealed that the average rice yield for the participants was 3076.67kg/hectare and the yield of non-participants was 1103.33kg/hectare. The income of participants was N5936.89 while non-participants earned N21322.22. The participants' level of living was significantly higher ($p<0.05$) 5% than non participants. The findings in this study indicate that Tungan-Kawo irrigation project had positive impact on rice output, income and level of living of participants. The results of multiple regression shows that age, gender, education, extension contact and membership of cooperative society were the most important variables influencing the adoption of recommended rice production practices in Tungan-Kawo irrigation project. The participants revealed that inadequate capital, high cost of operation and maintenance were some of their constraints. The Federal Government should subsidize farmers' inputs such as fertilizer, agro-chemicals, irrigation facilities.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The farm sector remains the backbone of the Nigeria economy since independence, employing more than 70% of the country's population. Small farmers dominate the sector and provide the bulk of the nation's domestic food supply (FAO, 2003). The Nigerian farm sector is characterized by low productivity that has persisted since the early sixties. World Bank reports put the growth rate in total food production at less than 1.5% in the 1990s, compared to an average annual population growth rate of about 3% during the same period (World Bank, 2000). This has placed tremendous pressure on the farm sector and the economy at large, as limited foreign reserves have to be allocated to food importation in order to meet consumption requirements.

The increasing need of crop production for the rising population is causing the rapid expansion of irrigation throughout the world (Franji and Mahajan, 1996). Average yield of upland and lowland rain fed rice in Nigeria is 1.8 ton/ hectare while that of irrigation system is 3.0 ton/ hectare (PCU, 2004). Previous study conducted reveals that 3.0 ton/ hectare for upland and lowland system and 7.0 ton/ hectare from irrigation system is obtained in places like Nigeria and Senegal (WARDA and NISER, 2004).

The major constraint to increased agricultural production in Nigeria is inadequacy of rainfall,l most especially in the Northern States, (Toro, 1997). Large areas of land are left uncultivated, especially in the Sahel region of the North. Irrigation in Nigeria has become an issue of vital importance considering present population growth rate. Virk *et al*. (2004) noted that Asia's food security depends largely on the irrigated rice fields,

which account for more than 75% of the total rice production. Recent report shows that Nigeria population is increasing by 3.5% annually, while food production is increasing by only 2.5%. The Food and Agriculture Organization (FAO) for instance, has warned that by the year 2025, Nigeria will no longer produce enough food to feed herself, solely from rain fed agriculture (FAO, 2003). One of the complimentary measures that could be taken is to intensify irrigated agriculture (Abubakar, 2001). To assure food security in the rice consuming countries of the World, rice production would have to be increased by 50% in these countries by 2025 and, this additional yield will have to be produced on less land with less usage of water, labour and chemicals (Zeng *et al*., 2004).

Irrigated rice cultivation in Nigeria has a long history dating back to the colonial era, but it was not until the droughts of the early-to-mid seventies that concerted efforts were paid to irrigation development in the country. A substantial government investment of more than US$ 200 (₦300 million) was put into irrigation development between 1976 and 1990 (Musa, 1997). Irrigation perimeters range from large and medium-scale schemes found in the North where drought effects are more probable, to small-scale schemes developed in inland valley bottoms in the South and other parts of the country. Rice is the main irrigated crop, but other crops such as wheat and vegetables are also important (Shaib *et al*., 1996). Irrigated rice systems account for 10-16% of the total rice area in the country (Fagade, 2001). In addition to the variability in scheme sizes, these systems encompass varying levels of water control, ranging from partial water control in intensive lowland systems to full water control with possibilities for double cropping.

1.2 Problem Statement

Rain fed rice production accounts for the bulk of Nigerian agricultural production. It can be stabilised at low cost per hectare but will always be vulnerable to drought. Irrigated production can buffer the impacts of drought where it can draw on groundwater or stored surface water or a mixture of both. It is important that the policy positions of irrigated production within the broader context of rain fed production encourages a viable structure of public and private irrigation and with a balanced set of small, medium and large scale irrigated production (FAO, 2004).

The primary purpose of any nation for establishing, expanding and maintaining irrigation systems has been associated with the desire for national wealth and power. The use of public funds to execute irrigation projects are made with the intent which includes broad social goals which incorporate a balanced concern for the welfare of the farmer and the region in which he lives. In Nigeria, irrigation development is increasingly becoming part of a comprehensive river basin development strategy. Several river basin development authorities have been established (Erebor, 1983).

Irrigation is a powerful tool for rural economy. It can influence time of harvest which in turn can influence market prices thereby stabilizing farm economy. Bhattarai (2002) opined that irrigation development is like a normal good at the initial stage of development, where agrarian sector dominates over, and irrigation largely contributes to expansion of crop production and development of the nation. Like normal good, the demand for irrigation in any agrarian society increases steadily at the initial stages of development. Bai and Molnar (2008) observed that improved availability of irrigation water in agriculture will increase crop yield thereby increasing income and alleviating

poverty among the adopting producers. It is perhaps the recognition of the above stated roles of irrigation that the Nigerian government embarked on irrigation development through River Basin Authorities, for example, the Tungan-Kawo Dam and irrigation project. This is one of the multi-purpose projects embarked upon by the Upper Niger River Basin Development Authority with the aim of providing farm efficiency and income, through optimum water conservation and utilization practices. The Authority realised that agriculture remains dominant in the region and is a strong influence on the region's economy. It was conceived as far back as 1955 by the defunct Northern Nigeria Governments as a solution to the frequent flooding of valuable agricultural land in the project area by Rivers Ubandawaki and Bankogi. The reservoir was, therefore, intended to provide controlled facilities for down-stream irrigation of a gross area of 900 hectares as well as flood and drainage control works for about 1,215 hectares (Upper Niger River Basin Development Authority,1991).

Nigeria has invested in irrigation projects to counteract seasonal food shortages due to drought. Besides, the national goal of food self-sufficiency, the high cost of private water extraction and market distortions necessitated a huge investment on large-scale and public irrigation projects across the country. However, large-scale irrigation projects that have been developed so far have not been self-sustaining. Despite these attempts to develop irrigation projects, the irrigation potential remains largely untapped, because farmers' participation has declined, and the projects irrigate only small percentages of the land acquired or secured (Thaboni, 1997).

The activities performed by Tugan-Kawo irrigation Project are the following:

- Provision, operation and maintenance of dams and irrigation network facilities.
- Provision, operation and maintenance of night storage and compensatory reservoirs.
- Provision, operation and maintenance of pumps, sprinklers and other irrigation equipment.

Other services by the project are raw water supply, borehole sinking, land clearing and drilling preparation services, consultancy services on engineering, architectural and agricultural studies, plant and vehicle hire services and vehicle repair and servicing (NRBDA, 1991).

Also, in spite of the huge investments, the results of irrigation schemes are generally far below expectations. Hence, national objectives of irrigation development (e.g. self-sufficiency in food, earnings from experts or savings from imports, higher rural incomes) are seldom realized. Although literature on the disappointing results has been multiplying since 1970, it appears that lessons learnt are not put into practice (Oosterbaan, 1985).

Governments and non-governmental agencies have taken measures through the construction of dams, provision of farm inputs, credit facilities, extension services and other irrigation farming machines to intervene in the provision of irrigation resources (FAO, 2007). This is aimed at improving the availability of irrigation water in agriculture which could increase crop yield and which could in turn increase the standard of living and societal income (FAO, 2007).

Literature has also shown that the Federal Government of Nigeria (FGN) and various other international donors and bilateral organisations have invested extensively in the Public Irrigation Sector in Nigeria. However, the sector's performance has not had the anticipated impact on national food security, employment opportunities and economic growth (FAO, 2004).

Research has been earlier conducted on the effect of irrigation development project on income and income distribution (Nagogo, 2011).However, the impact of irrigation projects on rice production and the livelihoods of the participants, particularly of Tungan-Kawo irrigation project has not been addressed. This is the focus of this study, trying to generate research information to address the following research questions.

i. What are the socio-economic characteristics of the rice farmers participating in Tunga-Kawo dam irrigation Project?
ii. What is level of adoption of the recommended rice production practices by the participants?
iii. What is the impact of Tunga-Kawo irrigation project on rice production, income and level of living of the people?
iv. What are the socio-economic and institutional factors influencing adoption of recommended rice production practices in Tungan-Kawo dam irrigation Project?
v. What are the constraints encountered by the participants and the management of the Tungan-Kawo Irrigation Project?

1.3 Objectives of the Study

The broad objective of the study was to examine the impact of Tungan-Kawo dam irrigation Project on rice production and livelihoods of small holder farmers in Wushishi Local Government Area of Niger State. The specific objectives are to:

i. describe the socio-economic characteristics of the small holder rice farmers' participating in Tungan-Kawo irrigation Project;
ii. determine the level of adoption of recommended rice production practices by the participants.
iii. assess the impact of Tungan-Kawo irrigation Project on rice production, income and level of living of the people.
iv. determine the socio-economic and institutional factors influencing adoption of recommended rice production practices in Tungan-Kawo irrigation Project;
v. Identify and describe the constraints encountered by the participants and the managemen of the Tungan-Kawo irrigation Project.

1.4 Justification of the Study

Irrigation is generally considered as an effective method of increasing agricultural production. It can supply the water needed for crop growth when rainfall is limited or, in more humid climates, it can bridge dry spells and reduce agricultural risks (Oosterbaan, 1985). This research may serve as a basis for the government in designing similar developmental programmes. The findings of this research are expected to provide useful information for the policy makers and assist them in formulating appropriate policies that will increase farmers' accessibility to irrigation projects.

This research would also provide information relating to weaknesses and strengths of this project which in turn will prevent the repeated failures in the design and implementation of similar projects. Furthermore, the findings of this research will contribute to the existing literature, especially on agriculture based projects, which will serve as a planning tool for both governmental and non-governmental agencies.

Finally, 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 will inform each of the stakeholders the trend of performance and provide an indication of the correct course of action to improve the services. The study also stands to benefit the country in her drive to ensuring self-sufficiency in food production, as it will identify those variables that require urgent attention of the various stakeholders in the nation's irrigation agricultural sub-sector.

1.5 Hypotheses of the Study

The following null hypotheses were tested:

(i) Participation in Tungan-Kawo dam irrigation Project has no significant effect on rice output of the participants and non-participants.

(ii) Participation in Tugan-Kawo irrigation dam project has no significant effect on rice yield of the participants and non-participants

(iii) Participation in Tungan-Kawo dam irrigation Project has no significant effect on income of the participants and non-participants.

(iv) Participation Tungan-Kawo dam irrigation Project has no significant effect on the level of living of the Participants and non-participants.

CHAPTER TWO

LITERATURE REVIEW

2.1 Irrigated Agriculture

Irrigation has been practiced for at least 4,000 years, primarily because it allows for increased productivity through more optimal timing of water application. More recently, irrigated agriculture in combination with improved crop varieties and chemical inputs has led to 24 percent more food per person between 1961 and 1997, despite the population increase (PAGE, 2000). In addition to increase food security, there is a net increase in economic gains to farmers. It is estimated that around 5 percent of agricultural land globally (264 million ha) is irrigated, with South Asia (35%), Southeast Asia (15%) and East Asia (7%) showing a high dependency on irrigation. China and India represent 39 percent of the global irrigated area and Western Europe and United States have 13 percent, while sub-Saharan Africa and Oceania have less than 1 percent of their agricultural land irrigated (PAGE, 2000). Irrigation accounts for approximately 70 percent of the water withdrawn from freshwater systems for human use. Only 30-60 percent is subsequently used downstream, making irrigation the largest net user of freshwater. Estimates also show that the share of cropland that is irrigated has grown by 72 percent from 1966-1996. Developing countries tend to have scarce water resources and relatively larger agricultural demands; and as such will have greater water extractions, which in turn can have greater impacts on associated wetlands (PAGE, 2000).

While environmental impacts have been recognized as important in assessing agricultural projects, and assessment processes exist, active monitoring against baseline pre-project conditions have not kept pace with developments in productivity. Some

aspects often regarded as important in assessment are hydrology, water and air quality, soil properties, erosion and sedimentation, biological and ecological change, socio-economic impacts, ecological imbalances and human health (FAO, 1995) although all aspects are not often covered for a given project, due to external factors affecting project implementation. The classic example is that of dams, which have been constructed to control the natural variations of the hydrological cycles, so that the water is made available on demand for agriculture. Often the effects of flooding downstream and their benefits were not contemplated. The importance of natural flooding to fisheries and recession agriculture and groundwater recharge have been realized only recently (Acreman and Hollis, 1996).

2.1.1 Types of irrigation practices in Nigeria

The earliest method of irrigation was the impounding of natural floodwater on the flat land bordering rivers, as in Egypt. In the same way, rainfall can be impounded by bunkering. But the modern methods of irrigation commonly practiced in different scales in Nigeria include:

(1) Sprinkler Irrigation: Through which water can be supplied by overhead irrigation through a rotating sprinkler head, or through a series of holes in a pipe.

(2) Tubewells: In Nigeria, an increasing area is irrigated with water from tubewell. These are investment made on the large holdings. This method is only profitable if surplus labour was available and with help of a pump.

(3) Underground irrigation: This is the water supplied by surface irrigation, 20-30% is lost by evaporation. Consequently, such loses are eliminated by underground system where the water is placed directly in the root zone of a plant, using perforated plastic tubes through which water is pumped under pressure.

(4) Trickle or drip irrigation: This method of irrigation is practiced where water is scarce and it involves the movement of water in plastic piping through main laterals, sub-laterals and eventually through a very fine tube to each individual plant. It releases a continuous drip of water when irrigation is needed (World Bank, 1989).

Large-scale irrigation (greater than 500 hectares) usually comprises main storage or diversion works, full conveyance and distribution works. If the need arises, embankments for flood protection are also constructed. The main irrigation structures are usually operated by government irrigation agency. They may be under direct state management or allocated by an irrigation authority to small-scale tenants or farmers and a standard cropping pattern is often imposed on the farmers (Olofin, 1994).

The greatest socio-economic problem associated with irrigation is low return on capital investment. After farmers have invested heavily in the Fadama system, the expectation is comfortable profit at the end of harvest. The farmers expect that the margin of profit should be commensurate with his investment in terms of money, labour and time.

The benefits of irrigation development are numerous. Norman (1996) listed some of the benefit as follows:

(i) Increasing the range of choice of crops and of livestock, thus providing flexibility in decision- making;

(ii) Focusing more complete and efficient resource use;

(iii) Lessening the danger of crop failure and the range of yield fluctuations, hence reducing uncertainties;

(iv) Increasing the capacity of the land for input of other factors;

(v) Increasing the size of total farm business;

(vi) Shifting the factor- product curves towards higher input and greater production.

In addition, it is obvious that socio – economic gains are prominent features of Irrigation projects: generally to an agriculturist, irrigation promotes maximum yield per hectare. Socio-economic considerations may also be one of the advocates of irrigation. With irrigation, it is envisaged that there will be sufficient food availability in areas where irrigation is practiced and more areas of cultivated land with large output are the envisaged merits of irrigation farming. Dry season farming on fadama land has the twin advantage of crop diversification such that if a crop fails or damaged, other crop will ensure food security and economic returns as dry season crops allow the farmers improve household economic security and investment on one hand and money to buy food in case of crop failure on the other hand. This will boost economic fortunes of farmers and alleviate their problem in the event of adverse conditions or disasters (FAO, 2004).

Another argument for irrigation project execution derives from above. It was articulated that if all the above becomes the fortune of lots of farmers, they will more likely have the ability to improve production, individuals or more people are likely to be influential and end up as contact innovators and persons for development efforts. This is no doubt operation at higher socio-economic status. More material returns in terms of oxen owned by the farmers, dry season farming utilizing motorized pumps and wash boles or tube wells, motor vehicles becoming common means to transport goods to nearby and far away markets. Also, cash crop earnings are some of the envisaged indicators or boosts to farmers' socio-economic status. Irrigation may also enable governments to exercise greater control over farmers cropping decisions through extension services and possibly, make it easier to regulate agricultural taxation (FAO, 1997).

Indigenous irrigation on fadama has a long history in Northern Nigeria. Impact evaluation report on Nigeria by the World bank revealed that dry season farming on fadama land has been existence for between twenty and fifty years in this part of the country. The simplest indigenous irrigation method is the bucket-lift system or 'shadouf'. According to oral history from rural community leaders, the shadouf method was brought from the Sudan over a century ago by trans-saharan traders. While such devices are low cost and depend mostly on farmers' labour for construction and operation, their irrigation potential is limited to small plots, water lifting by such devices is laborious and the area, which can be irrigated, is limited to about 0.1 ha per shadouf (World Bank,1995).

From the history of shadouf practice in northern Nigeria, while it can be adjudged as not new, the practice was restricted to a small proportion of farmers two or three decades ago. World Health Organization reported that in Sokoto state for instance, several community leaders stated that only about five to ten percent of the rural households were cultivating their fadama lands in the dry season twenty or more years ago, although, all the villages sampled had some in use at that time. Now, nearly all farmers are involved in recent years. This is an indication of the extent of change, which has occurred over the past decades (World Bank , 1995).

Shadouf practice is one of several irrigation methods in use in dry season farming in northern Nigeria. However, each method is dependent on the economic power of the farmers involved and the level of production. Whichever way, it is an established fact that dry season farming sustained by irrigation is a coping mechanism to extend the

length of farming period to boosted agricultural production and productivity (World Bank, 1995).

Since, agriculture in Nigeria is gender sensitive, it is apt to point out the fact that gender definition is crucial in this perspective because a common misconception concerning rural women in Northern Nigeria is that they are all in seclusion and therefore, economically and agriculturally in active. Women in purdah may not and do not, technically "work to earn a living", but many poor families are nonetheless and sustained by the economic activities of wives in seclusion (Callaway, 1987). It must however be emphasized that women in purdah do not actually work on the farmland, particularly during their years of childrearing. Women are involved in dry season commercial crop production on family plots not on their own plots. This is why quite often women must take on additional work, but reap no economic security. Nonetheless, it is appreciated that women do involve in dry season farming. This is exemplified in World Bank (1995) study of Sokoto and Kano Agricultural Development Projects that many rural northern women own both upland and Fadama land that they inherited from their fathers, in accordance with Islamic tenets. In the case of a woman in purdah, a male relative may be responsible for the day to day management of the farm, but the woman owner has the profit or produce from the farm. Women who are not under seclusion, or only partially secluded, engage in production tasks such as planting, weeding and harvesting, as well as processing that is common to all women whether in purdah or not. The World Bank report further that the proficiency in farming of some women as illustrated by the case of a sixty years old woman from Sabiya village who was honoured as the Sarki Noma (best farmer) in the village. The woman has six plots of land, three of them in Fadama area, which she inherited. In another case, forty five

years old divorced woman came home to farm. She has both upland and Fadama land some of which she has inherited and others were purchased. She hires work bulls for her farm, sometimes jointly with other women farmers.

All of these underscore the importance of irrigation farming in the life of inhabitants of these areas particularly and the economic empowerment in general. This is predicated on the fact that, the women have benefited in some ways more directly. For instance, women made additional money by renting their Fadama land during the dry season to other farmers. Also, women traders make more money from their trade since Fadama farmers have more money to spend.

Several types of Irrigation have been practised and reported in the literature. However, the commonest among these in Nigeria includes the traditional, small-scale and large scale. Some of the traditional methods and small-scale adopted in many farm sites especially in northern parts of Nigeria include: the Shadouf, Pump, Gravity or Natural flow and calabash/bucket methods. These are generally referred to as small-scale Irrigation enterprises covering small land area and with less sophisticated Irrigation equipment. Under the traditional system, water sources for this system are mainly residual soil moisture, locally dug shallow wells, ponds and other depressions. There is virtually no government or any external organization's assistance and interference. The system is under local people in response to their wishes and felt needs (Umar, 1994). Under the small-scale, some farmers received assistance from government or external agencies.

On the other hand, modern irrigation depends on damming major streams to store and control the flow of water and to allow delivery in the desired amount whenever it's needed. Examples of modern irrigation in general use are surface irrigation, border or drip irrigation; corrugation and sprinkler irrigation (Cox and Akin, 1979). In another dimension, the modern irrigation types are further divided into two:

(i) Large-scale (gravity flow) irrigation. This is the type ofirrigation by which dams or water diversion structures and channels are built to transfer water to the field. This is very common in the dry belt of northern Nigeria.

(ii) Pump irrigation, by which water is pumped either from the groundwater or surface water sources to farm layout (Mohammed, 2002).

2.1.2 Irrigated lowland rice

The establishment of River Basin Development Authorities (RBDAs) in the 1980s gave a boost to rice schemes and irrigated lowland rice. Irrigation is supplied from rivers, dams, wells, boreholes, wash bores, and other sources to supplement rainfall for full rice crop growth (Imolehin and Wada, 2000). This system accounts for 18 percent of cultivated rice land and 10-12 percent of national rice supply. In parts of Ogoja, irrigation is by gravity. It is a system developed entirely by the farmers. They have incorporated the use of rice bran as organic fertilisers in the farming system. Apart from the Adani Scheme in Enugu state and Bida Scheme in Niger state, most of irrigated rice is in the Northern Guinea , Sudan and Sahel Savannas (Selbut, 2003**).**

2.1.3 Irrigation schemes

One of the stated purposes of the dams that have been constructed is that of bringing land into irrigation. In this regard they can be regarded as having failed in some cases

with only small amounts of land being brought under irrigated cultivation but in other cases they have been effective and today manage tens of thousands of hectares of land under irrigation. Adequate and efficient irrigation provides a reliable employment, increase cropping intensity, increase yield per hectare and eventually generate more income, hence, high standard of living for the farmer.

2.1.4 Relevance of the rice sector to the national economy

The food sub-sector of Nigerian agriculture parades a large array of staple crops, made possible by the diversity of agro-ecological production systems. The major food crops are: cereals (sorghum, maize, millet, and rice); tubers (yam and cassava); legumes (groundnut and cowpeas) and others (fruits and vegetables). These commodities are of considerable importance for food security, expenditures and incomes of households.

Of all the staple crops, rice has risen to a position of pre-eminence. At independence in 1960, rice was merely a festival food consumed mostly in affluent homes during religious festivals. However, the report of Akpokoje *et al.* (2001) indicated that since the mid-1970s, rice consumption in Nigeria has risen tremendously, (10.3% per annum) - a result of accelerating population growth rate (2.8% per annum) and increasing per capita consumption (7.3% per annum) due to changing consumer preferences. Rice production in Nigeria has expanded too during the same period (9.3% per annum), particularly as a result of vast increases in rice area (7.9% per annum) and to a lesser extent through yield increases (1.4% per annum). Notwithstanding, the production increase was insufficient to match the consumption increase, with rice imports making up the shortfall. Quantities imported have oscillated widely over this period, but lately have surged from 300,000 metric tons in 1995 to about 1,000,000 metric tons in 2001.

These **i**mports are procured on the world market and represent a substantial cash outlay for the Nigerian economy. The Nigerian President publicly complained of the unacceptably huge foreign exchange outlay of as much as about US$600 million to import rice alone annually. Nigeria has, therefore, decided to double her present output and become self-sufficient in rice by the year 2004. The estimated rice production under irrigation in Nigeria as at 2012 was 4425377tons (CBN, 2012).

The demand for rice has been increasing at a much faster rate in Nigeria than in other West African countries since the mid-1970s**.** For example, during the 1960's Nigeria had the lowest per-capita annual consumption of rice in the sub-region (average of 3 kg). Since then, Nigerian per-capita consumption levels have grown significantly at 7.3% per annum. Consequently, per-capita consumption during the 1980's averaged 18 kg and reached 22 kg in 1995 – 1999. Despite the catching up of per-capita consumption with the rest of West Africa, the Nigerian consumption levels still lag behind the rest of the sub-region (34 kg in 1995 – 1999). Consequently, increases in average growth rates in Nigerian per-capita rice consumption are likely to continue for some time.

A combination of various factors seems to have triggered the structural increase in rice consumption. These include rapid urbanization, ease of preparation that fits easily to the urban lifestyle of workers and general availability among food vendors and restaurants located in work places in urban areas. Rice indeed is no longer a luxury food in Nigeria and has become a major source of calories for the urban poor.

Seyoum (2007) from the study on evaluating the effects of irrigation on poverty reduction and income distribution in the Nile Basin found that irrigation, is a significant determinant of total income of rural households. Irrigation has been witnessed to have a greater contribution in reducing poverty incidence. Moreover, income of households that is attributable from irrigated lands was found influential in abating income inequality among rural households.

Manyoung *et al*. (2001) showed that gross margins for irrigating farmers were significantly greater than for dry land farmers. They further pointed out that the effect of irrigation on increasing crop production and incomes is even more marked in the dry winter season, when dry land production is impossible because of lack of rain.

2.2 Tugan -Kawo Dam and Irrigation Project

The project first featured in the Northern Nigeria Government Development plan of 1962-68 along with other reservoir projects like Sokoto – Rima, Yobe, South Chad Basin and Hadejia. Following the creation of North Western State, the project was transferred to it. In early 1976, the then Northern Western State Government commissioned a firm of consultant – Messrs Associated Engineers, to undertake necessary investigation and design works of the project. The Niger State Government inherited the project as a result of state creation in 1976. In 1977, the consultants submitted their preliminary report to the State Government. The project was eventually transferred to the defunct Niger River Basin Development Authority for execution in 1978. The consultants (Association Engineers) were again commissioned by the Authority to embark on the detailed designs of the project and production contract documents (UNRBDA,1991).

The entire area generally drains into Kaduna River. Two small tributaries to River Kaduna Namely: River Bankogi and Gabuko, flow through the area. The project consists of the following main engineering elements: Reservior/Dam structures, irrigation, flood and drainage structures, access and service roads and spillway and spillway channel extension (UNRBDA, 1991).

2.3 Socio-economic Characteristics of Farmers Participating in Agricultural Development Projects

Bamidele *et al*. (2010) reported that Education is known to facilitate farmers understanding and use of improved crop production practices. About three-quarters of the respondents had not had any form of formal education. However the remaining respondents have had one form of formal education or the other, at least primary school education. Also about half of the respondents had average household size of 3 members, while the other halve of the respondents have households that consist of over 5 members. The average household size is made up of 8 members with a coefficient of variation of 0.51.

The income receipt of farm household to a large extent affects the farmers' ability to pay for irrigation facilities. As household income increases the household becomes more capacitated to pay for irrigation facilities. Bamidele *et al*. (2010) further reported more than half of the respondents earned about ₦20,000.00 monthly from their crop harvest sales during the 2007 cropping season. The rest of the respondents earned about ₦40,000.00 as monthly incomes during the cropping season. His result implies that farmers' receipts from their farming activities are reasonably fair.

A study in Ghana on irrigated urban vegetable production (Emmanuel *et al.,* 2006) indicated that famers participating in irrigation project had some type of formal education and not all of them were non-literate. Most of the farmers fall between the average age of 40 years. Adekunle *et al.* (2005) in Katsina project reported that most farmers were male and involved in mixed farming. They indicated that, farmers belong to some category of organisations and more participants get hygienic source of water than non-participants. Literatures have shown that, these socio-economic characteristics of farmers influenced the adoption of innovations in project implementation. Evidence of this could be traced in Banjo *et al.* (2003). Such characteristics according to Jibowo (1980) and Deji (2005) affect agricultural productivity.

It is evident that the socio-economic characteristics of farmers play important role in agricultural development. Many past studies have demonstrated that personal characteristics of farmers affects their decision on adoption and have largely been found to include age, farm size, family size, mental flexibility, farm ownership, other occupation, frequency of agents-farmer contact, social status, level of living, exposure to mass communication media and other socio-economic factors (Adesina *et al*., 2000). Also Atala (1980) found that socio-economic factors such as formal education, cosmopoliteness and community status were positively related to adoption.

2.4 Adoption of Recommended Agricultural Production Practices

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. However, for rigorous theoretical and empirical analysis, a precise quantitative definition of adoption is needed. Such a definition must distinguish between individual (farm-level) adoption and aggregate adoption. Final adoption at the level of individual farmer is defined as the degree of use of a new technology in long-run equilibrium when the farmer has full information about the new technology and it's potential.

Agbamu (2006) reported that the rate of adoption of improved maize variety in 2005 was 25%. Ekong (2005) also stated that the level of adoption of improved rice variety in 2006 was observed to be 11%. Deji (2005) noted that there is a significant relationship between membership of cooperatives societies and the adoption of improved cassava variety in Oyo state, Nigeria. The result further indicates that the number of children assisting in farm work, sources of credit is positively related to membership of cooperative societies. Yahaya and Aina (2007) reported that most of the cassava farmers (97%) had access to information from extension agents. Others are: farmers 96%; radio 92%; posters and handbills 91%; and television 79%, while internet 10%, journal 45% and books 39% are relatively low. Minority opined that they received information from workshops, bulletins and drama on annual basis.

In a study conducted by Bahan (2009) on adoption of recommended agricultural practices by small farmers, it was found that the level of adoption of recommended technologies was low among the rubber farmers due to incomplete farm production technologies that were brought to the farmers, late delivery to inputs and services and no supervision provided after the initial stage. According to Sumathi and Budhar (2004)

metal storage bins used by small farm women had a high level of adoption because the structures were given at subsidized rate. A research by Wijeratna and De Silva (2002) on rice farmers showed that the level of adoption of some introduced practices was only 22.2%. The findings revealed that the recommended seeds do not have the required quality standards for rice seeds thereby affecting the quality standard for rice that was produced.

It is also considered that high level of adoption by farmers of research proven technologies are capable of increasing farmers' cash income, meeting their required daily food needs and promote general economic growth (NAERLS, 2000). Evaluation studies to ascertain the benefits cassava farmers derived from improved recommended practices established for them have been conducted in various places. One of such studies was carried out by Singh (1996) who reported that the cultivation of new improved cassava contributed significantly to the women farmers' house hold food security especially in the beginning of the rainy season when supplies of most food were exhausted.

Socio-economic factors have been reported to significantly influence adoption of agricultural technologies. In a survey report by the Institute of Agricultural Research (IAR, 2001) in Nigeria, women are being prohibited to be directly involved in farming activities in some communities in northern Nigeria because of religious limitations. The report therefore stated that sex composition in cowpea production is very vital as the role of each sex is seen as very crucial to the production of the crop. In her studies, Kamara (2009) reported that male adoption of soybean was higher than that of the female in Borno State. She however stressed the importance of the roles both sexes play

in soybean production and again stated that majority of households who adopted the soybean technology were those headed by males.

Various recommend cowpea production practices have been exposed to farmers these include; improved cowpea varieties, land preparation, seed treatment, sowing date, seed rate, spacing, fertilizer application, weed control, pest/diseases control, harvesting and storage (Olufajo, 2004). Mijindadi and Njoku (1985) in a study to assess the extent to which tomato innovations were adopted in cooperative and individual farms in Ikara area of Zaria found statistically significant associations between extension contact, membership of associations, credit availability and input delivery and farmers' awareness and adoption of horticultural innovations.

Singh and Varshney (2010) reported in their study that majority of the respondents (44.17 per cent) were found to be medium adopters, followed by low (37.50 per cent) and high (18.33 per cent) adopters. Farmers with more economic resources alone could adopt more production technologies. They further noted that the level of adoption may be due to the different constraints faced by the small size holding respondents. Majority of the respondents (65.00%) adopted the recommended varieties in their cultivation. In case of 54.17 per cent of the respondents, seed rate was adopted as per the recommendation. Singh and Varshney (2010) also reported that some of the respondents were not willing to take risk while raising their own nursery and the possibility of loss of seedlings during germination due to heavy rain, pest and disease attack. Only 40.83 per cent of respondents had adopted the recommended nursery practice in their cultivation. Most of the respondents expressed that they could not afford to take risk due

to poor germination of own seeds, pest and disease and root snapping problem during pulling of seedling.

Odoemenem (2010) noted in his study that only 52% of the respondent farmers adopted the used of fertilizer, insecticides and herbicides on their farms and 48% of the respondents did not apply chemicals and fertilizers in their rice farms. About 47% of the respondents did weed their rice plots 4 times during the farming season; 37% did weed 3 times; 10% weed twice while about 7% did not remember how many times they weed their rice plot during the farming season in review. He further stated that respondent farmers enumerated reason for following recommended practices. These include direct personal contact with extension officers and friends and visiting a demonstration farm. About 88% of the farmers indicated that the demonstration farm visit and regular extension officers were the reasons why they decided to try the new methods. Only 14% of the farmers stated that they decided to follow the practices because they observed a neighbour or friend doing the same thing.

2.5 Impact of Irrigation Projects on Output, Income and Livelihood of People

Irrigation has been shown to improve crop productivity, enable households to grow higher valued crops, lead to higher incomes and wage rates for family labor, benefit the poor and landless through increased food availability, and lower food prices (Hussain and Minur, 2003). An empirical result by Tesfaye *et al*. (2008) on their study on Filtino and Godino irrigation schemes in Ethiopia found access to small scale irrigation leads to increased and stable production, income and consumption. The adoption of treadle pump irrigation improved the poverty status of households and prevented households from falling into poverty (Mangisoni, 2008). Drip irrigation has been proved to increase

production of crops, reduced water consumption and environmental problems such as soil salinization and fertilizer run-off (Narayanamoorty, 2004).

Analysis of household data from 13 villages in Northern Mali shows increases in total household consumption, agricultural production, caloric and protein intakes, and savings, for households with access to irrigation (Dillon, 2008). In addition to increased production, irrigation reduces the variance of production levels from rainfall shocks. The analysis by Dillon also showed evidence of secondary effects of access to irrigation. Access to irrigation increased informal sharing of food between households within villages. These additional secondary effects may not be captured by project evaluations if only producer household consumption levels are evaluated. In addition to increased production, access to irrigation also reduces the variability of production. In India, the growth of crop output per year from irrigated areas had a 2.5 times lower standard deviation than growth rates of rain fed areas (Lipton, 2007). Stability in household food production is a major contributor to household food security. Reliable production benefits the rural poor most because of the limited access to coping mechanisms such as credit services, insurance, savings, and other sources of income.

Livelihood outcomes are the achievements of livelihood strategies. The results of farm income as well as family income shows that the households with good access to water had earned more income (₦289,300) per household for lowland and ₦363,700 per household for upland) compared to the households with poor access to irrigation water (₦84400) per household for lowland and ₦180500 per household for upland). More than half of the upland farmers still did not feel secure in their livelihood, however, which may be explained by land use policy in this area. Researchers on land use stated

that nearly all land in Mae Chaem watershed is classified as protected watersheds, and the 60,000 people living there (72% ethnic minorities) depend on these lands for their livelihoods. Only small areas of paddy field in lowland areas have official land tenure recognition, and although informal local land use institutions have provided a basis for managing community land for generations, they are vulnerable to pressure and encroachment from more powerful outside forces (Thomas *et al.,* 2002).

Lipton (2003) stated that irrigation can reduce poverty, through increasing production and income, and reduction of food price. This helps very poor households meet the basic needs associated with improvements in household overall economic welfare, protection against risks of crop loss due to erratic, unreliable or insufficient rainwater supplies, promotion of greater use of yield enhancing farm inputs and creation of additional employment, which together, enable people to move out of the poverty cycle.

Empirical evidence from Australia shows that a dollar worth of output generated in irrigated agriculture generates more than five dollars worth of value to the regional economy, which suggested irrigation development has a strong multiplier effect on other sectors of the economy (Ali and Pernia, 2003). Shah and Singh (2004) found in India that more irrigation means fewer people below the poverty line. Moreover, Fan *et al.* (2000) in their study on the role of public investment on growth and poverty, noted that government expenditure on productivity enhancing investment which includes investment in irrigation, has played a significant role in poverty reduction and enhancing productivity in rural China.

Bhandari (2006) using farm-level data collected from 324 households in Nepal, also indicated that shallow tub wells irrigation has generated a significant positive effect in increasing rice yields and overall farmers' incomes. An average yield of shallow tube well irrigation owners was increased by 86 percent when compared to that of rainfed farmers. The net income of shallow tube well irrigation owners exceed that of the rainfed farmers by ₦8280 per hectare, which has an obvious effect on the .ability of the farmers to reduce poverty and sustain their livelihood strategies. Moreover, Hussain and Hanjra (2004) also found that the productivity of irrigated lands were twice that of non-irrigated reference areas, the net productivity benefits defined as the difference in net output values between irrigated and non-irrigated lands varied widely across settings from ₦2760 to ₦72000 per hectare.

Lire (2005) in eight public managed micro dams and 29 surrounding villages in Tigray, Ethiopia showed that agricultural yield and farm profit have significantly increased in villages with closer proximity to the dams than in those farther away from the dam water resource. According to the study, the overall evidence suggests that carefully designed irrigation dams could significantly improve agricultural production and overall food security. Irrigation, not only contributes to increased crop production but, may also reduce variability in production through improved control of the crop environment. In this respect, an empirical study carried out in Nigeria showed that the proportions of population of irrigation beneficiaries that experienced crop failure and poor harvest dramatically declined in comparison to the pre-irrigation status (Babatunde,2006).

A study conducted by Madhusuda *et al.* (2002) in India, indicated that availability and access to irrigation infrastructure, coupled with the availability and access to new

technologies- high yielding varieties and fertilizers, were major underlying factors for the success of the green revolution in India. They noted that better access to irrigation has facilitated intensification of cropping practices and inputs used, and contributed to the "modernisation" of the agricultural sector. By creating more secure and stable rural communities, access to irrigation water can also help stop migration to already overcrowded cities and slums (Van Hofwegen and Svendsen 2000). This is supported by Hussein *et al.* (2002) that labour employment per hectare and wage rate were found to be significantly higher in irrigated settings than in non-irrigated settings in Sri Lanka and Pakistan.

Furthermore, a study conducted by Hussein and Hanjra (2004) in South and South-east Asia, found that higher labour employment and wage rates were reported in irrigated than rain-fed areas, and they concluded that this change in wage was a direct result of irrigation development. Furthermore, they provide evidence on the significant contribution of irrigation to employment generation in agriculture. They noted that the annual labour work per hectare in the Ganges-Kobadak irrigation system of Bangladesh was around 100 days more than that in nearby non-irrigated areas. This additional labour demand creates better full time employment opportunities for farm family members and also create employment opportunities for hired labour. Moreover, they indicted that hired labour used in irrigated settings was double compared to that of nearby non-irrigated areas and the wage rate was 15 percent higher in the former than in the latter areas.

Qiuqiong (2004) argued that the green revolution in Asia would not have happened without massive irrigation development. Without continuous irrigation, many countries

would have been unable to achieve the agricultural and economic growth rates required to achieve food security and reduce poverty. They state that, irrigation has been tremendously effective in generating a variety of benefits such as improvements in productivity, employment, wages, incomes and consumption expenditures which directly has an effect in reducing poverty within the irrigated perimeter. Van Koppen (1998) stated that small-scale irrigation schemes given their dispersed nature, and relatively small size, suitability for households under resource-poor conditions, small-scale water harvesting, are not likely to attract significant external support, although small-scale irrigation schemes do offer considerable potential for poverty eradication and equitable resource access.

Frequent drought and adverse economic conditions are the major problems faced by the irrigation sector in semi-arid areas of sub-Saharan Africa. To reduce risks associated with rainfall variability and increase yields of food crops, more public investments in yield-enhancing technologies—such as small-scale irrigation and irrigation management systems—have been recommended as one important rural development and poverty reduction strategy (Pinstrup and Pandya, 2001). Irrigation farming is one of the most important rural development investments that can have both direct and indirect impacts on poverty and food security in semi-arid tropical countries (IFPRI, 2002). Stephen (2004), indicates that in many Asian countries, irrigation would continue to play a major role in poverty alleviation by providing food security, protection against famine and expanding employment opportunities. However, access to irrigation has only been possible where there are adequate developed water resources. Postel *et al.* (2001) noted that with affordable drip systems, small farmers can shift from subsistence production to

production for the market. This doubles their income and greatly enhances household food security.

However, though water harvesting and supplemental irrigation technologies have greater promise for increasing crop yields; their adoption by farmers has been extremely limited, as the risk and costs seem to have outweighed the benefits. Francois *et al.* (2003) indicated that 4 micro dams and 2 river diversions irrigation projects in Tigray have been successful in enabling farmers obtain a certain amount of wealth suggesting that farmers involved in irrigation schemes have shown significant impovement in their livelihoods, and earn higher incomes than non- irrigation users.

Beneficiary households were able to produce enough for the year round household consumption, build household assets such as different livestock, and better improved houses which directly mitigate vulnerability to shocks. They also stated that irrigation offers the rural population an alternative source of employment and income.

Rosegrant (1992) examined this issue in diversion irrigation systems in the Philippines. He used an irrigation system simulation model to analyse the impact of irrigation on the variability in area, yield, production, and farm income. Irrigation more than doubled crop-year rice production and income. However, because the diversion irrigation systems studied were dependent on highly variable dry-season stream flows, irrigated dry-season production and income were highly variable compared to wet-season rainfed farming. Thus on a crop-year basis, production and income variability under irrigated conditions were slightly higher than under rainfed conditions. Although improved management of irrigation systems could reduce income and production disparities

among farmers within the system, it had little impact on system-wide variability. It was concluded that investments in irrigation infrastructure and management are not substitutes for other policies that will offset the adverse effects of production instability, such as buffer stocks or import management.

Assessment of the impact of small-scale irrigation on the rural poor, was undertaken by the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP). It involved an interdisciplinary study in five of its member countries in South Asia (Bangladesh, India, Nepal, Pakistan and Sri Lanka) (Ahmed and van Vuren, 1990). It was found that irrigation water, if properly utilised, could bring about significant changes in the production and socio-economic situation of the community concerned. In all of the ten case-study schemes cropping intensity increased. CIRDAP study showed that if small and marginal farmers have command over inputs, including irrigation water, then the impact of increased agricultural production becomes significantly positive. When trying to establish the impact of irrigation on employment and income, there does, however, tend to be a time lag between production of outputs and generation of impacts. Also, without base-line data, it is difficult to assess the changes that have occurred due to an irrigation scheme, or to attribute causality.

Despite these methodological limitations, it was concluded that by reducing risk in crop production and by increasing yields, irrigation can lead to a secured survival status for poor farmers and improve their "livelihood condition". The case-studies showed how small-scale irrigation helped farmers to fight impoverishment by reducing their indebtedness and "eliminating any contingency that the poor might fear". In Bangladesh for example, subsistence farmers now generate some marketable surplus of rice. The

standard of living of farmers in Bangladesh also improved when there was some increase in non-farm activities, and where incomes from petty businesses and services contributed to improving the condition of the poor. However, none of the ten case-study schemes showed a significant positive relationship between adoption of irrigation and generation of saving and investment in the agricultural sector. Accumulation of capital by farmers was thus not sufficient to lead to investment in agriculture and other sectors, but this was attributed to supply constraints faced by farmers with regard to inputs (Ahmed and van Vuren, 1990).

The CIRDAP study also considered whether small-scale irrigation had contributed to marginalisation or increased disparity in wealth and power. In Bangladesh, groundwater irrigation had a positive impact on all farmers, but the benefits were distributed proportionately to landholding size. Farmers stated that the introduction of irrigation had reinforced the traditional social system. In India, small-scale irrigation was thought to be an effective instrument for achieving distributive justice and alleviating rural poverty, such that priority should be given to the development of small-scale irrigation in backward and tribal areas. Irrigation was found to bring little distributional change in Nepal, where population pressure on the limited land was the main source of marginalisation.

In Pakistan, researchers concluded that small-scale irrigation could provide increased production and income to poor farmers in backward areas, but only when supplemented with a package of agricultural support services including training, credit and system monitoring and evaluation. In Sri Lanka, state intervention had eroded traditional social mechanisms for conflict resolution and water management, resulting in less equitable

outcomes for irrigation now, than had been the case in the past. None of the case-studies provided conclusive evidence that large landowners had benefited from small-scale irrigation at the cost of small and marginal farmers (Ahmed and van Vuren, 1990).

2.6 Factors Influencing the Adoption of Improved Technologies

The literature on agriculture technology adoption indentifies a number of factors affecting the decision to adopt a new agricultural technology (Adeoti *et al.,* 2007; Namara *et al*., 2007; Fotz , 2003; Feder *et al.,* 1985; Shrestha and Gopalakrishnan, 1993).

Characteristics of the household, especially those of the household head, had positive effect on the adoption decisions. The household head's age influences the attitude he or she may have towards a new technology; however, there is not a consensus in the literature with regard to the direction of the influence of age on adoption (Knowler and Bradshaw, 2006). It may be that younger farmers are more innovative and open to technological advances and be more willing to adopt a new technology (Diederen *et al*., 2003).

Education and skill level are positively related to adoption. Farmers with more education have been shown to adopt modern agricultural technologies sooner (Feder *et al.,* 1985). In addition to educational attainment, two indicators of the farmer's agricultural ability and propensity to adopt new technologies are included in this study.

Gender is an important determinant in technology adoption (Knowler and Bradshaw, 2006). Traditionally, men and women play different roles in small-scale agriculture.

Men often control household finances and decisions regarding purchases of agriculture technology and inputs. This social aspect may make men more likely to adopt new agriculture technology. On the other hand, it is often recognized that women are more aware or concerned with the food requirements of the family (Thomas, 1990). Women may therefore be more likely than men to recognize the advantages of irrigation equipment for increasing household food security and be more likely to adopt. However, modesty is a gender issue sometimes cited as a limitation to adoption of an agriculture technology such as the treadle pump. Some women have been reported to be uncomfortable using a treadle pump because of the elevated position and stepping motion required for operation (Kay and Brabben, 2000). The gender of the head of household is hypothesized to impact the adoption decision, but the effect could be either positive or negative.

Information plays an important role in the adoption decision (Feder, Just, and Zilberman, 1985). Information regarding the use, productivity, and risk associated with a new technology affects the farmer's choice. The extent of the farmer's information about irrigation technologies is proxied by the number of irrigation meetings, extension or agricultural fair events attended, as well as whether or not a neighbor or friend was using the irrigation equipment before the adoption decision. The amount of information a farmer has is expected to be positively related to adoption. The more information about the benefits, functioning, and cost of the equipment a farmer has, the less uncertainty there is surrounding the new technology and therefore is expected to increase the likelihood of adoption (Feder *et al.,* 1985).

The quality and topography of land can also influence the decision whether or not to adopt an agricultural technology (Zhou, 2008). It is expected that the farmer will be more likely to invest in the irrigation equipment if his land is good enough to produce a good return. In order to capture this, a variable classifying the soil quality and slope of the farmer's largest irrigated field is included. Land tenure also influences the adoption decision. The security of land tenure affects the expected returns from investments in the land. Secure land rights reduce the risk of losing the investment in the land and therefore are expected to increase the willingness to adopt an agricultural technology (Feder *et al.,* 1985).

Water cost and availability are also important determinants of drip irrigation adoption. In the study area of rural Zambia there are no fees or markets for water such as in many areas with larger scale irrigation schemes. With no explicit price for water, access to water is the main issue regarding water for irrigation for these farmers. A farmer with limited access to irrigation water will benefit little from an investment in irrigation equipment. Distance to the nearest water source for irrigation is included as a measure of the farmer's access to irrigation water. The further a farmer has to go to access water, the more costly irrigating will be and is therefore expected to discourage the adoption of drip irrigation equipment.

Income levels in the adoption year can both determine the adoption decision and be affected by adoption of the equipment. Therefore, a lagged income variable is included to control for varying financial levels that could determine the household's ability to pay for the cost of the equipment. It is expected that the income level of the household will be positively related with adoption. Access to credit is also an important factor in

new technology adoption (Feder, Just, and Zilberman, 1985). However, because of the general lack of financial credit use by farmers in the study sample, it is impossible to test any hypothesis on the impact of credit on technology adoption.

Many of the farmers in the sample are located in rural areas and are separated from markets and suppliers of irrigation equipment by inadequate transportation infrastructure. The distance from markets and the lack of adequate transportation represents a significant cost of time and money in obtaining the equipment. The distance to the nearest market for buying inputs is included and is expected to have a negative impact on adoption. Characteristics of different localities can affect the adoption decisions (Knowler and Bradshaw, 2006). A region variable is included to control for any differences between the regions from which the study sample was taken.

2.7 Constraints Faced By Participants of Agricultural and Rural Development Projects

In Nigeria like other places, project implementation has been characterized by many impediments the most important mentioned was the "top down" approach in which the rural farmers were not involved in the concept, planning and monitoring, which often leads to massive failures in the project implementation. Other factors that militate against project implementation (Wallace, 1979) included lack of understanding the socio-economic and socio-cultural and religious factors of the beneficiaries communities. In another study (Omokore, 2008) also reported policy inconsistency, lack of political support, shifts in approaches by successive governments, lack of effective institutional arrangements for implementation and inadequate of qualified manpower to provide effective leadership were identified as the major impediments.

In a study of farmers Edi *et al.* (2007) have shown that farming types and high dependency of household income on farming activity constrained farmer's participation, whereas previous experiences, easy access to implements, environmentally friendly farm practices and adequate compensation of extra costs encouraged participation in agric-environmental measures. Tarfa (1990) noted that fertilizer, water availability, capital, high cost of pond, labour, tractor, pest and diseases, marketing and prices were constraints to dry season irrigation farming.

Food and Agriculture Organization (1997) pointed out that many Sub-Saharan countries have realized the critical role of irrigation in food production, but a number of constraints have been responsible for a relatively slow rate of irrigation development in this region. The constraints include; relatively high cost of irrigation development, inadequate physical infrastructure and markets, poor investments in irrigation, lack of access to improved irrigation technologies, lack of cheap and readily available water supplies.

Food and Agriculture Organization (1997) further identified the following constraints to be affecting the capacity of farmers to invest and manage irrigation projects:

- Poor resource base of farmers
- Fragmented and small size of land holdings
- Unsecured or lack of land titles
- High interest rates
- Poor transportation and marketing facilities

Wagnew (2004) identified a number of constraints, which are hampering smallholder irrigation development in Zimbabwe. Some of them are:

- The high cost of capital investment in irrigation works when one considers that communal farmers are resource poor.
- Rural infrastructure to facilitate input procurement and produce marketing is weakly developed in some areas, for example roads, telecommunications and electricity.
- Lack of reasonably priced appropriate irrigation technology for the smallholders.
- Shortage of human resources at both technician and farmer levels.
- Poor catchments management, which results in siltation of some water bodies.

Food and Agriculture Organisation (1997) further identified the following constraints to be affecting the capacity of farmers to invest and manage irrigation projects:

- Poor resource base of farmers
- Fragmented and small size of land holdings
- Unsecured or lack of land titles
- High interest rates
- Poor transportation and marketing facilities

The same report also identified technologies that might be appropriate for the smallholder farmers like:

- Treadle pumps and other manual pumps including hydraulic rams.
- Sprinkler irrigation including conventional systems and drag-hose.
- Micro-irrigation systems such as pitcher, porous clay pipes, micro-sprinklers, bubblers and drips.

While there is literature confirming positive impacts of micro-irrigation, there is a lack of reliable empirical evaluations of policies and programs which promote it. Many programs are implemented without any rigorous evaluation of impact. The effectiveness

of micro-irrigation programs can vary due to the local circumstances of small-scale farmers. A wider base of research evaluating specific programs will provide needed information about what is effective in different settings (Stewart, 2005). The techniques of program evaluation and the estimation of the counterfactual situation require controlling for selection bias or designs that employ randomized treatment (White, 2005).

2.8 The Concept of Appropriate Technology

In an attempt to locate irrigation as an appropriate technology in agrarian revolution in Nigeria, it is wise to clearly define appropriate technology, which is defined as the systematic application of collective human rationality to the solution of problems through assertion of control over nature and all kind of human processes. In this context, agricultural technology may be viewed as the application of specific technology for the promotion and development of agriculture (Umar, 1994). Furthermore, appropriate technology designed for peasant farmers should comprise the set of objectives or gadgets that will unlock new resources, increase productivity and generate new capacities to produce goods and services on the farms.

The choice for appropriate technology, according to Erhabho and Nwagbo (1985) should be based on the socio-cultural considerations of the farmers with particular reference to simplicity of the technology, such that vast majority of the farmers can put it into practice at reasonable cost and returns such that the technology should minimize total cost and maximize profit. Also, national sovereignty considerations in the choice of the technology should be viewed for national economic consciousness. In addition, the World Bank (1989) recommended that for a project to be appropriate and viable it

should be formulated and designed so that it is sustainable under prevailing socio-economic conditions and be seen as an advantage to those intended to benefit from it and the use of national resources efficiently. It has also been recognised that the major infrastructural facilities are only one of the entwined technical, social and economic factors which determine the success of any irrigation project. The users' participation and their acceptance of the new technology depend on their involvement in the selection, design and construction of the project. The most serious problem in the irrigation development do not relate to storage and delivery of water alone, but the success of irrigation programme in the long run also covers water resources management, control of salinization and water logging (World Bank, 1989).

One way to formulate technology appropriate and adaptable to farmers' criteria and resource base is by analyzing the socio-economic and biophysical constraints of farmers' production. This requires both ecological and economic approach, which formalizes the body of complex relationship implicit in traditional farming systems (FAO, 2007).

In comparing alternative water lift technologies, many variables must be considered. The rationale choice depends on the resources and environment situation of each farmer. Factors like water supply (source), labour supply, farm size, marketing among others must be considered (Erhabo and Nwagbo ,1985; Jamusz, 1990). In order to plan sound land and water development programmes, it is important for concerned agencies to have clear and accurate information about the present uses of these resources.

Agrarian revolution in Nigeria is incomplete without due recognition of the socio-economic implication of irrigation. Therefore, socio-economic status shows a glance of the position of an individual in their social and economic conditions in both relative and absolute terms. Idowu (1986) defined socio-economic status of the farmers as the position of individual or group, relative to others in the society. He further stressed that ones social position depends on whom one is and with whom one is compared. He also define socio-economic status as the position an individual or family occupies with reference to the prevailing average standard of cultural position, possessions, effective income, material possession and participation in the group activities of the community.

2.9 The Concept of Socio-economic Status of Farmers

Beckley (1986) viewed socio-economic status as the position, which an individual occupies within a social, cultural and economic context. Therefore, socio-economic status gives a picture of an individual and his family in respect of their relative social and economic standing in the society. Therefore, socio-economic status is what shows educational background, an attainment level, that is their economic, social and cultural well-being. Onwueme and Ugbor (1994) noted that, for one to attain a middle class status in modern society, he must have a good education and income. In Nigeria, education at least at the university level required for entry into the professions and attainment of middle class status.

Patel and Anthonio (1974) in their **c**onstruction and standardization of scale to measure socio-economic status of rural families in Western Nigeria, included material possessions, social participation and cosmopoliteness as indicators of socio-economic status (SES). It is evident in several studies in Nigeria that various kinds of relationships

exist between these variables. The specific criteria, which determine whether an individual or groups has high or low status, depend on the characteristics values in that society. Idowu (1986) stated that specific criteria which largely determines socio-economic status in most societies has being in the order of importance as in occupation, Income and wealth, education, Cosmo politeness, ownership of material possessions, example: real estate, tube well, pump, automobile, house, clothing, farmlands, family name, background, race, and nationality.

In another perspective, Yahaya (2002) postulated that several indicators are used to determine the socio-economic status (SES) of women farmers in North-Central Nigeria. Some of these include; farm size and crop types; possession of different type of animals such as cattle, goat, sheep, poultry, camel and pig; plastered and painted houses and different type of furniture; carpet, floor mat, bed sets, large family bed and spring iron bed; different type of plates (stainless, breakable and aluminium plates), metal spoons and different type of boxes ('echolac' cloth box, portmanteau, metal and wooden box types) and jewelry, different type of gold plated and ordinary wrist watches, necklace, bracelet, ear rings and finger-ring.

2.10 Theoretical Framework

This study was guided by the theory of social change, the perspectives on community development , participation and the impact assessment.

2.10.1 The social change theory

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.

Theories of social change have, in general, been concerned with the explanation of (a) the sources of social change (b) the time span of change and (c) the effect of change on the changing unit. Social change impinges on the society as well as on the individual. At the individual level, the academic emphasise or concern has been on (a) how the individual learns of innovations; (b) his motivation to change; (c) how he adjusts to change and (d) the societal and personal factors impeding social change. Social change is an ever present phenomenon in any society it is the essence of human existence, development and growth (Robinson, 1982) and Moore (1989) defined social change as the significant alteration of social structure in the society. In the same light Rogers (1982) posited that social change as the process through which significant alteration occurs in structure and function of the society.

This theory will help to provide the framework for the understanding of the social changes that have taken place in the life of irrigation farmers as a result of the introduction of the Tungan-Kawo irrigation project. It has provided.

2.10.2 The Community development perspective

Community development is restructuring of the economy in order to satisfy the material needs and aspirations of the community and to promote individual and collective incentives to participate in the process of development (Idowu, 1986 and Lee, 2005). It involves a host of multi-faceted activities, including the improvement of agriculture. The promotion of industries in the community, the creation of the requisite infrastructure and social overheads as well as the establishment of appropriate decentralized structures in order to allow mass participation (Lee, 2005). This will be useful in analysing the changes in the livelihood and standard of living of the people that have resulted from the implementation of Tungan-Kawo dam irrigation project.

2.10.3 The impact assessment perspectives

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

Impact studies is of great importance in agricultural research because it is used to identify alternative technologies that would address the major production constraints while at the same time taking into consideration farmers preferences and farming condition (Alene *et al.,* 2006). According to Impact Assessment and Evaluation Group(IAEG) in using impact assessment as accountability exercises to justify past programme activities, impacts should be evaluated in terms of all the goals and objectives that were set when the project activity or programme was established , (IAEG, 1999).

The term "impact" refers to the broad, long-term economic, social and environmental effects resulting from research (IAEG, 1999). The impact of a programme can be seen in relation to what the programme actually do to the people who participate in them. It is the actual programme outcomes in relation to the desire outcome, in determining the impact of social interventions.

Food and Agriculture Organization (1997) gave the following as some of the benefits of irrigation: Increased income that was translated into increased expenditure, investment, construction and trade, backward and forward linkages: traders were reportedly coming to purchase irrigation produce (rice) and in turn sell cloth, jewellery and other consumer items and increased material wealth. At the village level, this was in the form of construction of a large mosque built through farmers' donations and an improvement of the village clinic. At household level, increased wealth could be seen in 55 houses built in the village, fourteen with corrugated metal roofing.

Irrigation development aims to bring about increased agricultural production and consequently to improve the economic and social well being of the rural population. Properly implemented smallholder irrigation with appropriate technologies may have a considerable potential in improving rural livelihoods, although the viability of such systems becomes questionable when the financial responsibility rests entirely on the community in the absence of institutional support services that enhance market orientation (Kamara *et al*., 2002; Shah *et al.,* 2002).

Irrigation has the potential to increase agriculture production and improve the livelihoods of small-scale farmers. Irrigation is linked to poverty reduction through its effect on crop production and increased farm income. Adequate water supply to crops increases the production available for household consumption and or sale. Irrigation can enable farmers to have a second and sometimes a third crop planting, increasing income for the farmer. In addition to increasing overall production, irrigation increases the reliability and consistency of production (Smith, 2004). Irrigation enables the farmer to control the available water throughout the growing season, which boosts production and reduces exposure to water shortfalls or seasonal droughts. In many areas where rainfall is inadequate, unreliable, or incorrectly timed, reducing the farmer's dependency on suitable weather patterns is important for the best production.

Sanginga *et al*. (1999) stated that impact analysis deals with the investigation of the changes that occurred or likely to occur on the people's life as a result of a project or program. According to them, impact assessment tries to find out how far the introduction of technology have been successful in meeting the socio-economic objectives and how well agricultural technologies have satisfied the needs and priorities

of household and other units in the target population. The impact of a programme can be seen in relation to what the programme actually do to the people who participate in them. According to Patton (1978) it is actual programme outcomes in relation to the desired outcomes (goals) in determining the impact of social interventions. Impact of social intervention can, therefore be defined as an output of the organisation which is related to the achievement of the programme objectives.

Impact assessment is a criteria component of agricultural research in that it helps to define priorities of research and facilitate resource allocation among programs, guide researchers and those involved in technology transfer to have a better understanding of the way new technologies are adopted and diffused into farming communities and show evidence that client benefits from the research products (Manyong *et al*., 2001).

Awa (1986) noted that the design for measuring agricultural development efforts musts not be at variance with the programmes initiation and implementation strategies. In conducting impact assessment, researchers often use "with" and "without" impact method, while others use "before" and "after" method. The "with" and "without" approach to impact study involves the study of population, villages or communities that benefited or did not benefit from the execution of a project. Through this method, the researcher is able to find out the difference between the beneficiaries and non-beneficiaries, or participants and non-participants.

For the purpose of this study, the "with" and "without" method of impact assessment will be used.. This is because using this approach will give the differences between the participants and non-participants in terms rice output, income and level of living. This

perspective will help to determine the quality of services provided by Tungan-Kawo irrigation project on the livelihood of the farmers.

2.11 Conceptual Model

Conceptual model developed for this study will observe the changes over time among the project participants. The project interventions might have brought changes. The observed changes will be computed over time period between 2005 and 2011. The same procedure will also be applied for the non-participants. The changes observed overtime among the participants and non-participants will produce an estimate of the impact of the project on changes in rice output and yield (rice production), changes income and level of living (livelihood). This is based on the assumption that the project intervention will create changes among the participants and a spill-over effect on non-participants.

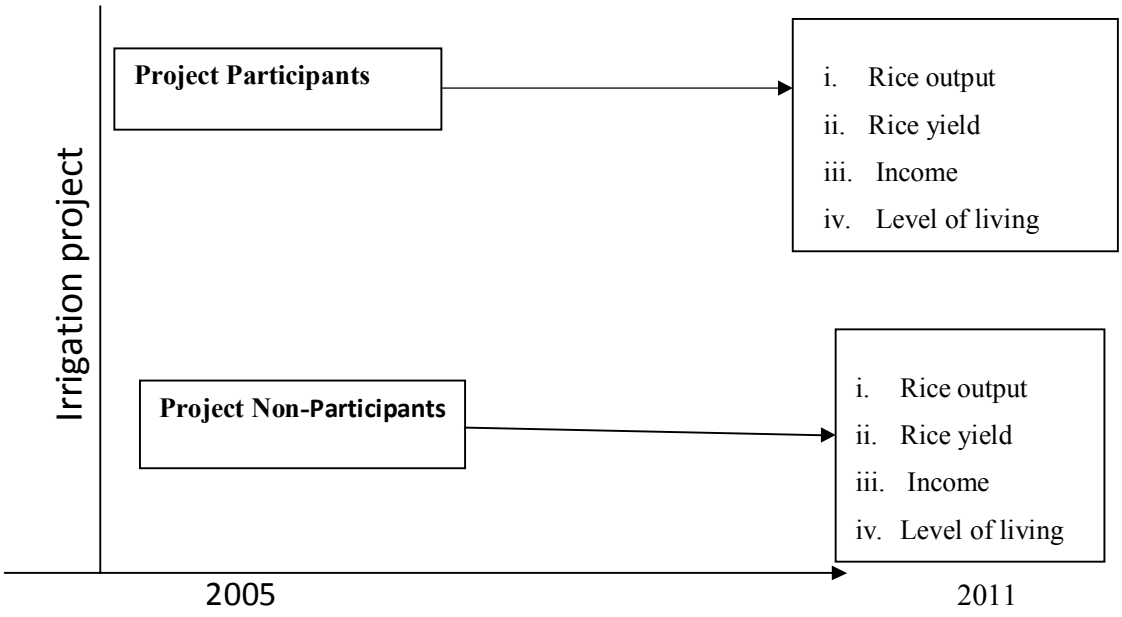


Figure I: A model of the impact of Tungan-Kawo dam Irrigation Project on rice output, rice yield income and level of living of the people.

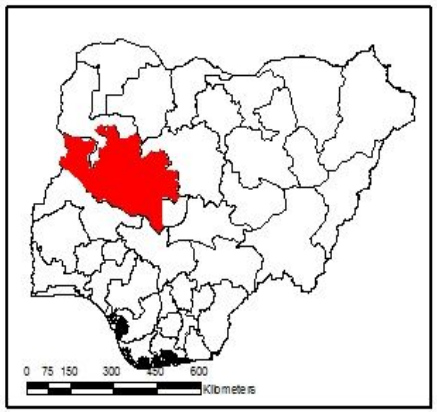
CHAPTER THREE

METHODOLOGY

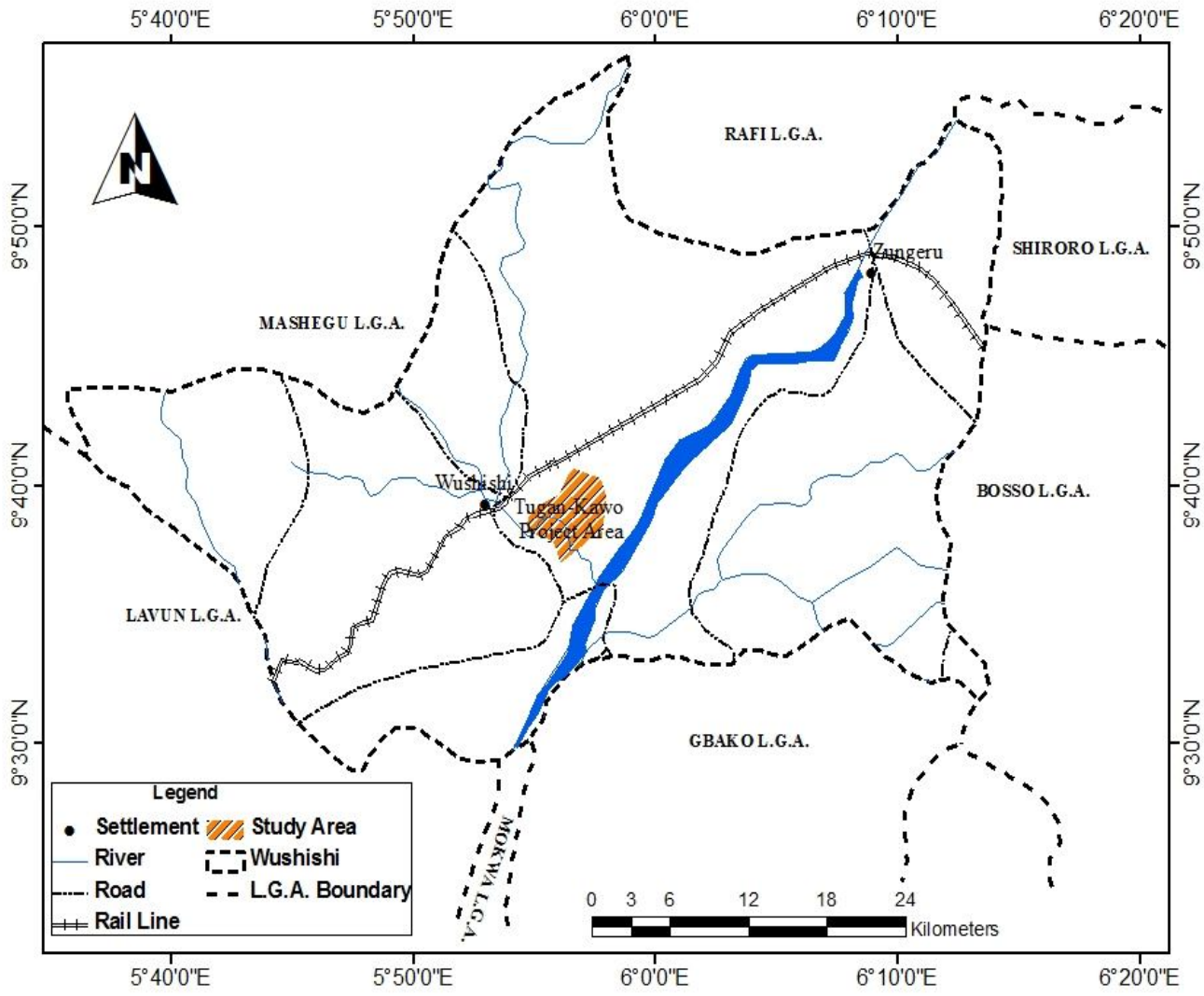
3.1 The Study Area

Niger State is one of the 36 states in Nigeria. It was created from the defunct North-Western State on 3rd February, 1976. The state is located in the middle belt of Nigeria. It is located between latitude $8^0$22'N and $11^0$30'N and longitude $3^0$30'N and $7^0$20'E. Niger State is in Guinea Savanna region of Nigeria. The State is bordered in the North by Zamfara State, to the North- west by Kebbi State, to the South by Kogi State; while Kaduna and FCT boardered the state Northeast and Southeast respectively. The State shares a common international boundary with the Republic of Benin at Babanna in Borgu Local Government Area of the State (Salisu, 2013).

Niger State has a total of population of 3,950,249 (NPC, 2006) with a projected population of 4,772,024 as at 2012 when the data was collected. The State covers a total land area of 76,363sq.km, or about ten percent (10%) of Nigeria's total land area. The State is made up of twenty-five Local Government Areas (LGAs). The study was conducted in Tungan Kawo Dam and Irrigation project in Wushishi Local Government Area. Wushishi Local government has a total of population of 81783 (NPC, 2006) with a projected population of 98796 as at 2012. It is bordered by Gbako Local Government to the south, Rafi and Bosso Local Government Areas to the east, Mariga Local Government Area to the north; Mashegu and Lavun Local Government Areas to the west.







MAP OF NIGER STATE SHOWING TUGAN-KAWO IRRIGATION PROJECT

Agriculture is the back bone of the economy of Niger State, more than eighty percent (80%) of the population depends either directly or indirectly on it for their livelihood.

The Tunga-Kawo irrigation project is located at latitude 9.5°N and longitude 6.25°E. The dam was commissioned in 1988 and irrigation project started in the same year. It was built across the flood plains of Rivers Ubandawaki and Bankogi. It is located at 7.5 km from Wushishi town in Wushishi Local government Area of Niger State. The reservoir was therefore, intended to provide control facilities for downstream irrigation of an area of 900 hectares. The dam and irrigation network were constructed with a 250 ha irrigable area. A number of communities are located downstream of the scheme and these communities depend on water from the drainage channels in the scheme for their domestic needs. Rainfall is strongly seasonal, and occurs between May and October, with the peak rainfall occurring in September. The annual rainfall ranged between 1200 and 1300 mm. The dry season lasts between November and March. The mean monthly maximum and minimum temperature are 37.3°C and 19.7°C, respectively, and the hottest months are February, March and April. Rice is the only cultivated crop in the study area. Fishermen also operate at the dam area (UNRDBA,1991).

3.2 Sampling Procedure

Multi-stage sampling procedure was used for this study. Wushishi Local Government Area of Niger State is made up of two districts that is Wushishi and Zungeru districts. From the reconnaissance survey conducted as at 2011, a list of two-hundred and forty-three (243) participants was obtained from the programme office. Thirty seven percent (37) percent of irrigated participant farmers were randomly selected from the list of 162 participants in Wushishi district. Also, 37% of the participants were randomly selected

from the list of 81 participants in Zungeru district. Therefore a total of 90 participants were used for the study. In order to effectively study the impact of Tugan Kawo irrigation project on participants, ninety (90) were also selected as a control group for comparative analysis. Each of the two group, participants and non-participants were ninety (90) participants each making a total of one hundred and eighty (180) respondents from the two districts in the study area. Also 10 management staff were randomly selected to assess the performance of the participants.

Table: 3.1 Distribution of the Respondents in the Study Area

Districts	Participants			Non-participants		
	Population	37% of population	Actual sample size taken	Population	37% of population	Actual sample size taken
Wushishi	162	60	60	162	60	60
Zungeru	81	30	30	81	30	30
Total	**243**	**90**	**90**	**243**	**90**	**90**

3.3 Methods of Data Collection

This study made use of primary source of information. The primary data were collected from the participating and non-participating rice farmers in the study area, as check list for the management of Tungan-Kawo Irrigation project. These were collected with the aid of structured questionnaire. The information that were collected included socio-economic characteristics as well as living condition of both participating and non-participating rice farmers, the impact of irrigation project on the output and income of the participating and non-participating farmers, the constraints encountered in the implementation of the irrigation project in the study area.

3.4 Analytical Techniques

The following analytical tools were used to achieve the objectives of the study; these include; descriptive statistics, Z-test statistic and multiple regression.

3.4.1 Descriptive statistics

The descriptive statistics was used to achieve objectives (i), (ii) and (v). This involved the use of frequency, percentage mean, standard deviation and coefficient of variation.

3.4.2 Z-test statistic

Z-test statistic was used to achieve objective iii to measure the impact of the project. It is used for samples greater than thirty (> 30). Z-test model in this study compares the differences in crop output, income and level of living between the participants and non-participants of Tungan-Kawo irrigation project.

The Z-test model represented as follows:

$$Z = \frac{\bar{X} - \mu}{S_{\bar{X}}}$$

Where,

Z= The calculated Z-test

$\bar{X}$ = Mean of the samples

μ = Mew: the theoretical mean of the irrigated rice output, the peoples' income and level of living

$S_{\bar{X}}$ = Standard error of the mean

Z = Significant at 5% (two-tailed) test = 1.96

3.4.3 The multiple regression model

This was used to achieve objective (iv) of the study. The model is specified in the form below;

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + \varepsilon$$

Where:

y = Crop output (Paddy rice, 100kg/bag)

x_1 = Education (Years)

x_2 = Farm size (Hectares)

x_3 = Farming experience in rice production (Years)

x_4= Credit availability (Actual amount)

x_5 = Extension contact (No of contact/year)

x_6 = Membership of association (Years)

x_7 = Household size (Number)

a = Constant term

ε = Error term

b_1 to b_7= Regression coefficients

3.5 Operationalization and Measurement of Variables

3.5.1 Independent variables

The dependable variables affect productivity and performance of irrigated agricultural practices under a given irrigation system expected to be provided by Tungan Kawo Irrigation project. These characteristics include:

Extension Contact: This is a meeting the respondent has with extension officials. It was measured by the number of visits or contact per year with extension workers of the Tungan-Kawo irrigation project. Farmers contact with agricultural extension agent has been reported to improve adoption of technologies (Smith *et al.,* 1994)

Access to capital: This represents farmers access to loan received either in cash or in kind. It was measured by the total amount of money borrowed from the Tugan-Kawo irrigation project credit scheme. Capital support has been shown to influence adoption of improved rice technologies under irrigation project.

Subsidies on inputs: It describes a package of farm inputs made available and accessible to farmers at reduced cost. It was measured by the total amount of subsidy enjoyed on production by the Tugan-Kawo irrigation project subsidies scheme. Subsidies have been shown to increase the use of farm inputs.

Motorized pump schemes: This refers to the availability and accessibility of water pumping machines provided by the Tugan-Kawo project throughout the period of production. It was measured by 1= available, 0= not available.

Tractor hiring services: The availability and accessibility of tractors for rent to farmers by Tugan Kawo Irrigation Project during the period of production. It was measured by 1= available, 0= not available. This would increase the size of farmland under cultivation.

3.5.2 Dependent variables

The dependent variables are farmers' benefits in terms of changes in farm output, changes in farm income and improved level of living resulting from participation in the project.

Level of Adoption: Rogers (1995) defined adoption as "the decision to make full use of an innovation or technology as the best source course of action available. In this study, the technologies that were introduced to the farmers were the following: improved varieties, recommended planting dates, recommended plant depth, recommended plant spacing, recommended fertilizer, weed control and recommended harvesting method.

Rice output: This referred to the total quantity of produce obtained by a farmer adopting irrigated agricultural practices within the season of the study. It was measured in 100 kilogram bags obtained by individual farmer.

Yield of rice: This is the total output of rice produced by the farmer at the end of the growing season divided by the total hectares of land under rice production. This was measured in ton per hectare because output is not enough to tell whether the farmers are doing well or not until one is able to find out their level of productivity which measures yield.

Income: This referred to the total money received by the farmer from rice production. It was measured in monetary value (naira).

Level of living: This referred to the well-being of farmers or relating to quality of living. It was measured by the ownership and usage of assets possessed by the farmers. Example are freezers, motorized pumps, sprayers, automobiles, televisions, radios, houses, farmlands and different types of animals such as cattle, goat, sheep and poultry computed in a monetary value for an individual farmer to determine his/her level of living. Increase in income is not enough to tell whether the farmers are doing well or not until one is able to translate it into their level of living. That is by indicating differences in the ownership and usage of income from irrigated rice and assets owned computed in monetary value. In this study, impact was measured by comparing the rice out output, yield, income, and level of living of participants and non-participants using Z-test statistic.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Respondents

The first objective of the study was to describe the socio-economic characteristics of the respondents. The socio-economic characteristics discussed in this section were age, gender, marital status, education, major occupation, farm size, household size, cooperative membership, extension contact and access to credit.

4.1.1 Age distribution

The results presented in Table 4.1 showed that the average ages of participants and non-participants farmers were 44.14 and 44.44 respectively. The maximum ages were 65 and 68 for the participants and non-participants respectively. The minimum age for participants was 23years while non participants were 21 years. These results implied that both participating and non-participating farmers were in their active age group and these were within the agricultural productive age range of between 30-55 years reported by Food and Agricultural Organization (FAO, 1995). Age is very important in agricultural production and livelihood activities. Adubi (1992) argued 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 improved agricultural technologies, and other production-related decisions. Farmers in their active age could be participating in Tugan-Kawo irrigation project in order to increase their income level to cater for the dependents within their household units. Furthermore, since majority of farmers practising irrigation farming were young and young farmers are energetic irrigation farming business could be expanded for increased agricultural productivity.

4.1.2 Gender of the respondents

As shown in Table 4.1, about 98% of both the participants and non-participants are male farmers while only 2% of participants are female. This implied that male farmers dominated irrigated rice farming in the study area. This result was similar to result obtained by Oluwatayo (2009) who noted that majority of his respondents were males engaged in different livelihood activities in his study area Ownership of land which is traditionally against women may be the reasons why women are not engaging in rice production in the study area. The results also agreed with the findings of Emodi (2009) who found that majority of the respondents were male.

4.1.3 Marital status of the respondents

The results presented in Table 4.1 showed that majority of the respondents (83%) were married. Only 13% of the participants were single. This implied that more than three quarter of the farmers participating in Tugan-Kawo irrigation project were married. This agreed with the findings of Sabo (2006) who found that majority of the participants and the non-participants were married. It is expected that family labour may be more available where the household heads are married because the number could inrease. Marital status may influence the size of households as married farmers may have larger household sizes which may encourage them to participate in agricultural projects in order to raise their income and level of living.

4.1.4 Educational level

Distribution of the respondents by their level of educational (Table 4.1) indicates that 16%, 23% and 32% of the participants had primary, secondary and tertiary education respectively. On the other hand, 9%, 23% and 22% of non-participants had primary,

secondary and tertiary education respectively. Only 3 and 7 of participants and non-participants do not have formal education. This implied that respondents in the study area had one form of education or the other. Educational attainment is very important because it could lead to awareness of the possible advantages of modern farming techniques which could enhance productivity (Najafi, 2003) .

However, the participants were more educated than non-participants this agreed with the findings of Idi *et al.* (2006) in which they reported that participants of the programme were more educated than the non-participants.. According to Muhammad-Lawal *et al*. (2009) who said that farmer's level of education is expected to influence farmers' adoption of agricultural innovations and decision on various aspects of farming. They also reported education as highly important for sustainable agricultural growth and development since their study revealed that majority (94%) of the agricultural programme participants had some form of formal education implies that the participant are not likely to have much difficult in understanding and adopting modern agricultural technologies and innovations.

Table 4.1: Socio-Economic Characteristics of Participants and Non Participants(Age, Gender, Marital Status, Education)

Variables	Participants		Non-Participants	
	Frequency	Percentage	Frequency	Percentage
Age				
21-30	13	14.44	19	21.11
31-40	24	26.67	13	14.44
41-50	28	31.11	30	33.33
51-60	20	22.22	27	30.00
61-70	5	5.56	1	1.11
Mean	44.14		44.44	
Minimum	23		21	
Maximum	65		68	
Gender				
Female	2	2.22	1	1.11
Male	88	97.78	89	98.89
Marital status				
Single	12	13.33	14	15.44
Married	75	83.33	76	83.45
Divorced	3	3.33		
Education				
No formal education	3	3.33	7	7.67
Qur'anic education	17	18.89	23	25.33
Adult education	6	6.67	10	11.00
Primary education	14	15.56	8	8.78
Secondary education	21	23.33	21	23.11
Tertiary education	29	32.22	20	22.22

4.1.5 Respondents' major occupation

As shown in the results presented in Table 4.2. It was revealed that majority (51%) of the participants' major occupation were farmers. About 11% and 10% of the participants were traders and craft workers. About 8% of non-participants were traders. This indicates that respondents in the study area engaged in multiple activities which would enhance livelihood diversification. This agreed with the findings of Yahaya (2002) who noted that the ever-increasing socio-economic crises and poverty had forced people to opt for livelihood diversification in order to support their families.

Involvement in multiple activities by the respondents in the study area would enable them to cope with livelihood risks associated with single source of income.

4.1.6 Household size

The distribution of the respondents by their household size as shown in Table 4.2 revealed that 50%, 28% and 13% of the respondents have household size ranged between 3, 8 and 12 respectively while 11%, 49% and 36% of non-participant had household size ranged between 1-5, 6-10 and 11-15% respectively. The average household size of participants and non-participants were 7 and 5 persons respectively. These results indicate that the household size of the participating farmers is fairly large compared to non-participating farmers. The fairly large household size of the participating farmers could be the reason for participants' participation in the programme as a means of generating and diversifying income and livelihood in order to cater for the family. Size of the household may enhance labour availability that can be used for different activities. The significance of household size in agriculture may enhance the availability of labour for farm production.

4.1.7 Respondents' farm size

The results presented in Table 4.2 revealed that 44 and 32 of the participants had farm sizes ranging between 1-2 and 3-4 ha respectively. About 12% of the participants had farm size greater than 6 hectares. Among non-participants, more than half 53.3% had farm size between 1-2 hectares. The average farm sizes were 2.03 and 1.44 hectares for participants and non-participants respectively. These results showed that participants had farm sizes greater than non-participants. However, majority of rice farmers in the study area both participants and non-participants were small scale farmers. According to

Ozowa (2005) farm sizes less than 10 hectares were classified as small scale farmers. This finding is consistent with Ekong (2003) who reported that most Nigerian farms are small-sized family farms in which family members contribute the required labour. Najafi (2003) argued that food production can be increased extensively through expansion of area under cultivation. Therefore under subsistence agriculture, farm size is expected to play a significant role in influencing a farm household's income because size of the land under cultivation will determine the size of output which could be translated to farm household income.

Table 4.2 Socio-economic Characteristics of Participants and Non Participants(Major Occupation, Household Size and Farm Size)

Variables	**Participants**		**Non-Participants**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Major occupation				
Civil servant	23	25.56	46	50.56
Craftworks	8	8.89	7	7.67
Animal husbandry	3	3.33	3	3.33
Trading	10	11.11	8	8.78
Farming	46	51.11	27	29.67
Household size				
1-5	45	50.00	10	11.00
6-10	25	27.78	44	48.89
11-15	12	13.33	32	35.56
Above 15	8	8.78	3	3.33
$\bar{x}$	7		5	
Farm size				
1-2	40	44.44	48	53.33
3-4	29	32.22	31	34.44
5-6	10	11.11	5	5.45
7-8	3	3.33	3	3.33
9-10	5	5.56	1	1.11
above 10	3	3.33	2	2.22
$\bar{x}$	2.03			1.44

4.1.8 Extension contact

As shown in Table 4.3 majority of the respondents (92%) in the study area had contact with extension agent while 7.8 percent do not have contact with the extension. About 38% had contact between 1-5 times while 19 percent had contact between 6-10 times per year. Only 8 had extension visit above 20 times. This implied that there is need for more extension activities among the participants of Tugan-Kawo irrigation projects. Contact with the extension can lead to improvement in food production as a result of information on improved agricultural technologies which will enhance greater productivity. About 6%of the non-participants had extension contact. Similarly, Chery *et al.* (2000) found that the adoption of new technologies is often influenced by the frequency of the farmer's contact with extension agents. The relationship between agricultural extension agent and the farmer could be an important determinant in the adoption and sustenance of improved farm practices such as recommended rice production practices.

4.1.9 Access to credit

As shown in Table 4.3 only 34% had access to credit while about two-third (66%) do not have access to credit. This implied that rice farmers in the study area were using their personal saving for rice production. About 3% of the non- participants had access to credit. Access to credit is very important because this may enhance farmers' participation in agricultural project activities. Also, accessibility of farmers to credit facilities may increase their access to agricultural inputs which may increase food production.

Table 4.3: Distribution of Respondents Based on their Extension Number of Contact and Access to Credit

Extension contact (per year)	Participants		Non-participants	
	Frequency	Percentage	Frequency	Percentage
No contacts	**7**	7.78	85	94.44
1-5	34	37.78	3	3.33
6-10	17	18.89	2	2.22
11-15	13	14.44	Nil	Nil
16-20	12	13.33	Nil	Nil
above 20	7	7.78	Nil	Nil
Average	10		2	
Access to Credit				
Accessible	31	34.4	2	2.22
Not accessible	59	65.6	88	97.78
Total	**90**	**100.0**	**90**	**100.0**

4.1.10 Membership of cooperatives

The results in Table 4.4 revealed that 30% of the participants had 1-5 years of membership. The average years of membership for participants were 8 years. About 94% of the non-participants do not belong to cooperative. The average years of membership for non-participants were 4 years. This result implied that all the participants of Tugan-Kawo irrigation projects are members of cooperative societies which may be due to their awareness of the benefits of cooperative societies. This indicates that participants farmers were properly organized for easy access to agricultural information and credit facilities. Membership of association or cooperatives avails a farmer the opportunity of not only obtaining credit and agricultural inputs but also information on how to improve his farming activities. Ekong (2003) and Ajayi (2009) stated that participants in cooperative societies have the following advantages, such as micro-credit, input subsidy and also as avenue for cross breeding of ideas and information. Only 2% have been in the cooperative for over 20 years. Membership of cooperative can enhance the accessibility of farmers to credit facility and serve as a

medium for exchange of ideas that can improve their farm and non-farm activities (Oyewole, 2012).

Table 4.4: Distribution of the Respondents Based on their Membership of Social Organizations and years of Membership in such Organizations

Years of membership	**Participants**		**Non-participants**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
No membership	Nil	Nil	36	40.0
1-5	16.28	30.11	19	21.1
6-10	38	42.2	21	23.3
11-15	17	18.9	12	13.3
16-20	5	5.6	2	2.2
above 20	2	2.2	Nil	Nil
Average	8		4	
Total	**90**	**100.0**	**90**	**100.0**

4.11 Performance of the Participants of Tugan-Kawo Irrigation Project

The results in Table 4.5 showed the performance of the participants of Tugan-Kawo irrigation project. It was revealed by the management of the project that 70% of the participants were very satisfied with the performance of the respondents. A total of 20% were satisfied while only 10% were less satisfied with the performance of the participants. None of them were not satisfy with their performance. This finding implies that respondents participated actively in most of the activities carried out by Tugan-Kawo irrigation project and this could boost their income level as well as improving their level of living. This also indicates that participants in the area had greater interest in the project.

Table 4.5: Performance of the Participants of Tugan-Kawo Irrigation Project

Performance	Frequency	Percentage
Very satisfactory	7	70
Satisfactory	2	20
Less satisfactory	1	10
Not satisfactory	Nil	Nil
Total	**10**	**100**

4.2 Level of Adoption

The second objective of this study was to indentify the level of adoption of recommended rice production practices by the farmers. Results in Table 4.6 revealed that 98% adopted planting of improved rice varieties such as FARO, NERICA and WITA. About 9% and 62.22% have adopted recommended planting dates of July-August and depth of 2.0cm respectively. Those who adopted recommended plant spacing of 20 x 20 and fertilizer i.e. NPK (100kg/ha), SSP (188kg/ha) and Urea (200kg/ha) constitute 82% and 85.56% respectively. In the case of weed control and recommended harvesting method about 85% and 94% respectively have adopted these practices. These results showed that the adoption of recommended rice production practices was very high. This is because more than half of the respondents have adopted one practices or the other. The high level of adoption among the participants implied that rice farmers in the area attached relative advantage to improved method of production practices for greater productivity which will eventually translate to higher income and level of living.

Table 4.6: Distribution of Respondents according to Level of Adoption of Recommended Rice Production Practices

Major Recommended rice production practices Adopted	Participants		Non-participants	
	Frequency	Percentage	Frequency	Percentage
Improved rice varieties	88	97.78	18	20.0
Recommended planting dates	83	92.22	49	54.44
Recommended plant depth	56	62.22	33	36.67
Recommended plant spacing	62	68.89	43	47.78
Recommended fertilizer	74	82.22	6	6.67
Weed control	77	85.56	26	28.89
Harvesting	85	94.44	13	14.44

4.3 Impact of Tungan-Kawo Irrigation Project on Rice Output, Yield Income and Level of Living of Participants

Objective three was to access the impact of Tunga-Kawo irrigation project on rice production, income and level of living of the participants. Four hypotheses were formulated to achieve this objective.

4.3.1 Rice output of participants and non-participants

The results in Table 4.7 showed the impact of Tugan-Kawo dam irrigation project on rice output. It was revealed that the average rice output for the participants was 1.175tonne per year and the output of non-participants was 0.767 tonnes. The estimated difference was 0.407 and this was 35%. The calculated z-value was 3.41 and this was greater than z-table value (1.96) this implied that the output of the participants was significantly ($P<0.05$) higher than the output of non-participants which indicates that Tunga-Kawo irrigation project has impact on rice production in the study area. This result conform with the apriori expectation because it is expected that participants of the projects would have access to facilities and extension information which in turn increase their yield.

Based on the findings of this study, the null hypothesis was rejected because Tugan-Kawo irrigation project has significant effect on rice output of the participants and non-participants.

Table 4.7: Results of Z-statistic Showing the Impact of Tugan-Kawo Irrigation Project on the Rice output of the Respondents in the Study Area

Group	Mean Output (tonne)	St. Error	St. Dev	95% confidence	Interval
Participants	1.175	0.087.81	0.833	1000.67	1349.63
Non-participants	0.767	0.074.46	0.706	619.74	915.63
Difference	0.407	0.119.44	1.133	170.13	644.80

z-value = 3.41*** *** P < 0.01

4.3.2 Rice yield of participants and non participants

As shown in Table 4.8, the average rice production yield of participants was estimated to be 3076.67kg/ha, while the yield of non-participants was 1103.33kg/ha. The results showed a difference of 1973.33kg/ha (64%). The calculated z-value (11.05) was greater than the z-table value (1.96) and this showed that the rice yield of the participants was significantly ($P<0.05$) higher compared to the non-participants which implies that Tunga-Kawo irrigation project has impact on rice production in the study area. This could be attributed to Tungan-Kawo projects extension services which resulted to the adoption of improved farming practices and provision of production facilities by the project. Based on the findings of this study, the null hypothesis was rejected because Tugan-Kawo irrigation project has significant effect on rice yield of the participants.

Table 4.8: Results of Z-statistic Showing the Impact of Tugan-Kawo Irrigation Project on the Rice Yield of the Respondents in the Study Area

Group	Mean Yield(kg)	St. Error	St. Dev	95% confidence	Interval
Participants	3076.667	151.9088	1441.133	2774.827	3378.506
Non-participants	1103.333	84.51152	801.7467	935.4107	1271.256
Difference	1973.333	178.5697	1694.061	1618.519	2328.148

z-value = 11.05*** *** P < 0.01

4.3.3 Income of participants and non-participants

The result in Table 4.9 shows the income of participants and non-participants of Tungan-Kawo Irrigation project. It was revealed that the estimated average monthly income of participants was ₦59363.89 while non-participants earned ₦21322.22 per month. The difference in income was ₦38041.67 which could be expressed as 64%. per The calculated z-value was 7.5 and this was significant at 1% level of probability which implied that the monthly income of the participant was significantly higher than monthly income of non-participants. These findings indicate that the project has significant influence on the income of the participating farmers. This result is similar with the findings of Abdullahi (2005) who found a significant difference in income between participants and non-participants in his study of some agricultural programmes. Based on the findings, the null hypothesis which states that there is no significant difference between income of participants and non-participants was rejected and the alternative that there is significant difference between the income of the Tungan-Kawo irrigation project participants and non-participants was accepted.

Based on the findings of this study, the null hypothesis was rejected because Tugan-Kawo irrigation project has significant effect income of the participants and non-participants.

Table 4.9: Results of Z-statistic Showing the Impact of Tugan-Kawo Irrigation Project on the Income of the Respondents in the Study Area

Group	Mean Income (₦)	St. Error	St. Dev	95% confidence	Interval
Participants	59363.89	3774.081	35804.08	51864.87	66862.91
Non-participants	21322.22	2952.248	28007.49	15456.17	27188.28
Difference	38041.67	5045.208	47863.05	28016.95	48066.39

z-value = 7.5* * P < 0.01

4.3.4 Participants and non-participants' level of living

The results in Table 4.10 revealed that participants' level of living which was estimated to be ₦1760292 while non-participants level of living was ₦854997.80. It was measured by the ownership and usage of assets possessed by the farmers and computed in a monetary value. The z-calculated on level of living (3.93) was greater than the critical z-value (1.96) and this was significant at 5% level of probability. Based on the findings of this study, the null hypothesis was rejected because Tugan-Kawo irrigation project has significant effect on level of living. The implication of this is that the participants' level of living was significantly higher compared to non-participants. These results implied that Tungan-Kawo irrigation projects exert positive and significant influence on the level of living of the participating farmers. This result is in agreement with the findings of Akpoko *et al.* (1998) in their study of impact of non-governmental agricultural extension training programme in Zaria, Nigeria.

Table 4.10: Results of Z-Statistic Showing the Impact of Tugan-Kawo Irrigation Project on the Level of Living of the Respondents in the Study Area

Group	Mean Livelihood (₦)	St. Error	St. Dev	95% confidence	Interval
Participants	1760292	184725.8	1752463	1393246	2127339
Non-participants	854997.8	121801.3	1155508	612981.2	1097014
Difference	905294.7	229784.5	2179927	448717.8	1361872

z-value = 3.93* * P < 0.05

4.3.5 Perceived benefits by participants of Tungan-Kawo irrigation project

The results presented in Table 4.11 showed the respondents opinion about the benefits of Tugan-Kawo irrigation project in the study area. About 99% perceived that the project gave them access roads. Only 18.89% perceived the provision of storage facilities while the majority (97) of the respondents perceived easy access to market. Those that perceived access to extension activities constitutes 93 %. This indicates that the extension component of the projects is functional and the agricultural information flows through extension agents to the project participants. About 94% perceived the supply of irrigation water was the benefits of the project. This indicates that majority of participating farmers had access to irrigation water as a result of the project. Musa (2004) observed that irrigation water is an important factors influencing participation and determining the crop output of the farmer.

Table 4.11: Perceived Key Benefit by Participants of Tungan-Kawo Irrigation Project

Benefits	Frequency*	Percentage	Rank
Access roads	89	98.89	1
Easy access to market	87	96.67	2
Supply of irrigation water	85	94.44	3
Access to extension services	84	93.33	4
Electricity	77	85.56	5
Health care services	76	84.44	6
Recreation	76	84.44	6
School	75	83.33	8
Community network	74	82.22	9
Storage facilities	17	18.89	10

* Multiple responses were allowed

4.3.6 Wage earning opportunities created by Tungan-Kawo irrigation project

As shown in Table 4.12, it was revealed that there was different income generating opportunities available to the participants of Tungan-Kawo irrigation project. This implied that respondents in the study area diversify their income sources for increased income and better level of living. About 98% of the respondents engaged in trading activities and this could be attributed to increased economic activities created by the projects. Those that engaged in craft work constitute 62% while fishing and bricklaying activities constitute 96% and 77% respectively. Furthermore, about 98% worked as hired labour while the project also created the opportunities of repairs of pump and machine. About 63% reported sales of machines spare parts as rural wage earning opportunities. Majority (77%) also reported commercial transportation which is also an income generating activities as a result of Tugan-Kawo irrigation project.

Table 4.12: Wage Earning Opportunities Created by Tugan-Kawo Irrigation Project

Employment opportunities	Frequency	Percentage
Trading	88	97.78
Craftwork	56	62.22
Fishing	86	95.56
Bricklaying	54	60.00
Transportation	69	76.67
Hired farm labour	88	97.78
Repairs of pump machines	57	63.33
Sales of spare parts	57	63.33

4.4 Socio-economic and Institutional Factors Influencing Adoption of Recommended Rice Production Practices

The fourth objective of this study was to determine socio-economic and institutional factors influencing the adoption of recommended rice production practices in the study area. The result of the regression analysis in Table 4.13 reveals the factors influencing the adoption of rice recommended production practices in the study area. The R^2 value was 0.67 this implies that 67% of the variation in the adoption of rice production practices was due to the independent variables considered in the model. The result showed that the estimated coefficient (0.074) of age was positive and significantly ($p<0.01$) influential to the adoption of rice production practices. This implied that a unit increase in age would increase adoption by 0.074 unit. The importance of age lies in its effect on the adoption of innovations and the processing of information. This result is consistent with the report of Yenealm (2006) who found that there was a positive relationship between age and adoption behaviour of farmers. They reported that older farmers are more likely to adopt improved technologies than younger farmers. The estimated parameter for sex was positive and significant at 1% level of probability. This indicates that sex is proportionally related to the adoption of recommended rice

production practices. This agreed with the findings of Agbamu *et al*. (1996) who reported that the sex of the respondents was insignificant at 5% level of probability to the adoption of agricultural technologies.

Education was positive and significant at 1% level of probability. The positive coefficient of educational status means that there is a direct relationship between adoption of recommended rice production practices and educational status, whereby as educational status increases, adoption level also increases among farmers. The results is in line with Teressa (1997) who noted that the higher the level of education a farmer attains, the better the chances of understanding and adoption of a technology. Njoku (1991) in his study on factors influencing adoption of improved oil palm production technologies by small scale farmers in Imo state Nigeria, noted that the more educated a farmer the more the chances that he/she will utilize available opportunity and adopt innovation than uneducated ones. It is expected that the higher the educational level, the higher the level of adoption. And generally, the low level of education of the farmers affects the adoption of innovation, especially one that is complex. The finding is also similar to the finding of Agbamu and Orhorhoro (2007) who found that educational level positively and significantly influences the adoption of recommended practices.

The coefficient (0.184) obtained for extension contact was positive and significant at 1% level of probability. This suggests that adoption of recommended rice production practices by farmers in the study area increased as contact with the extension agents and farmers become more frequent. Availability of extension services and information about recommended rice production practices play an important role in determining level of adoption.

This finding is in agreement with Idrisa *et al*. (2008) who found a positive contribution of extension contact to adoption. Kassie (2009) also noted that contacts with extension services give farmers access to information on innovation, advice on inputs and their use as well as management technologies.

The coefficient (0.462) for membership of associations was positive and significant at 1% level of probability. Membership of association can provide means of interaction with other farmers and this can also provide avenue or forum through which innovation can be diffused among farmers. Membership of association affords the farmers the opportunity of sharing information on modern farming practices by interacting with other farmers.. This finding is in line with Salawu (2007) who found that social organizations are made up of different categories of adopters. As innovators and early adopters interact with late majority and others, it would influence the outlook of other categories to adopt. It also concurred with finding of Benjamin (2010) who found that social organizations serve as fora through which members could exchange ideas, learn new farm practices and have access to information.

Table 4.13: Multiple Regression Results of Socio-Economic Institutional Factors Influencing Adoption of Recommended Rice Production Practices

Variables	Coefficients	Standard Error	t-value
Constant	14.904	2.317	6.43
Age	0.074	0.034	2.21**
Gender	5.321	1293.	4.11***
Marital status	0.0.786	0.715	1.10
Household size	-0.049	0.041	-1.18
Education	0.774	0.164	4.69***
Years of participation	0.021	0.070	0.31
Farm size	0.010	0.068	0.15
Distance from the dam	0.058	0.062	0.94
Extension contact	0.184	0.023	7.80***
Cooperative membership	0.462	0.049	9.30***
Access to credit	0.662	0.544	1.22

R=0.68
$R^2 = 0.67$
$R^{-2} = 0.65$
***P<0.01; **P<0.05

4.5.1 Constraints Faced by the Participants

The results presented in Table 4.14 showed that 92% of the respondents experienced quilea birds invasion. About 94% had problem of limited irrigated land. Irrigated farm land is very important in irrigated rice production as it determines the scale of rice production. About 97% had inadequate capital and this was ranked first among the constraints. Availability of capital would encourage farmers to invest on large scale irrigation farming. It will also enhance the adoption of improved farming practices. Lim and Douglas (1998) emphasized that poverty in most rural areas is still a significant barrier for small-scale farmers. Pest and disease was also among the constraints faced by the farmers in the study area. About 93% of the respondents reported outbreak of pests and diseases.

Table 4.14: Distribution of Respondents according to Constraints Faced by Farmers in Tungan-Kawo Irrigation Project

Problems	Frequency*	Percentage
Inadequate capital	87	96.66
Inadequate irrigated land	85	94.44
Pest and diseases	84	93.33
Quilea bird invasion	83	92.22
High cost of operation and maintenance	81	90.00
Flooding	5	5.56

*Multiple responses are allowed

4.5.2 Constraint faced by management in the implementation of Tugan-Kawo irrigation project

The results presented in Table 4.15 showed that 90% reported inadequate funding as the major constraint faced in the implementation of the project and this constraint was ranked first this was followed by inadequate cooperation from the participants while poor loan repayment was the least constraint. Inadequate funding may limit the procurement of inputs and material needed in the implementation of the project.

Table 4.15: Constraints Faced by Management in the Implementation of Tugan-Kawo Irrigation Project

Constraints	Frequency*	Percentage	Rank
Inadequate funding	9	90	1
Inadequate cooperation from the participants	8	80	2
Poor maintenance of facilities by the participants	3	30	3
Poor loan repayment	2	20	4

*Multiple responses allowed

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study was conducted to assess the impact of Tungan-Kawo dam irrigation project on rice production and livelihood of small holder farmers in Wushishi Local Government Area of Niger State,Nigeria. The specific objectives were to describe the socio-economic characteristics of small holder rice farmers' participating in Tungan-Kawo irrigation project, identify the level of adoption of recommended rice production practices by the participants, examine the impact of Tungan-Kawo irrigation project on rice production, income and level of living, assess the socio-economic and institutional factors influencing adoption of recommended rice production practices and to identify the constraints encountered in the implementation of the project.

Primary data were used and these were collected with the aid of structured questionnaire. The respondents were purposively drawn from Wushishi and Zungeru districts, Wushishi Local Government Area of Niger State. Data were analysed using descriptive statistics, z-test statistic and multiple regression model.

The results showed that the average age of participants and non-participants farmers were 44.14 and 44.44 respectively. About 98% of both the participants and non-participants were male while only 2% of participants were female. About 97% of the farmers participating in Tugan-Kawo irrigation project were married. The average household size of participants and non-participants were 7 and 5 persons respectively. About 15%, 23% and 32% of the participants had primary, secondary and tertiary education respectively. On the other hand, 9%, 23% and 22% of non-participants had

primary, secondary and tertiary education respectively. Only 3 and 7% of participants and non-participants do not have formal education. It was revealed that majority (51%) of the participants major occupation was farming. About 11% and 10% of the participants were traders and craft workers respectively. About 8% of non-participants were traders. The average farm sizes were 2.03 and 1.44 hectares for participants and non-participants respectively. Majority of the respondents (92 percent) had contact with extension agent while 8 percent do not have contact with the extension. Only 34% had access to credit while about two-third (66%) do not have access to credit. A total of 87% of the respondents do not belonged to cooperative societies, while 13% did belong to cooperative society.

The second objective of the study was to determine the level of adoption of recommended rice production practices which were introduced to the participating rice farmers in the study area. It was revealed that 98% adopted planting of improved rice varieties such as FARO, NERICA and WITA. About 9% and 62% have adopted recommended planting dates of July-August and depth of 2.0cm respectively. Those who adopted recommended plant spacing of 20 x 20 and fertilizer i.e. NPK(100kg/ha), SSP(188kg/ha) and Urea (200kg/ha) constitute 82% and 86% respectively. In the case of weed control and recommended harvesting method about 85% and 94% respectively have adopted these practices.

The study further showed that the average output of participants was estimated to be 3076.67kg/ha while the output of non-participants was 1103.33kg/ha with a difference of 1973.33kg/ha (64%). The calculated z-value (11.05) was greater than the z-table value (1.96) and this showed that the output of the participants was significantly higher

compared to non-participants. It was revealed that the average rice yield for the participants was 1.175tonne and the yield of non-participants was 0.767 tonnes. The estimated difference was 0.407 and this was 35%. The calculated z-value was 3.41 and this was greater than z-table value (1.96) this implied that the yield of the participants was significantly higher than the yield of non-participants. It was also revealed that the estimated average monthly income of participants was ₦59363.89 while non-participants earned ₦21322.22 per month. The difference in income was ₦38041.67 which could be expressed as 64 percent. The calculated z-value was 7.5 and this was significant at 1% level of probability which implied that the monthly income of the participant was significantly higher than monthly income of non-participants. It was also revealed that participants' level of living was estimated to be ₦1760292 while non-participants level of living was ₦854997.80. The z-calculated on level of living (3.93) was greater than the critical z-value (1.96) and this was significant at 5% level of probability.

About 99% perceived that the project gave them access roads. Only 19% perceived the provision of storage facilities while the majority (97%) of the respondents perceived easy access to market. Those that perceived access to extension activities constitutes 93 %. The results also showed that there was different income generating opportunities available to the participants of Tungan-Kawo irrigation project. About 98% of the respondents engaged in trading activities and this could be attributed to increased economic activities created by the project. Those engaged in craft work constitute 62% while fishing and bricklaying activities constitute 96% and 77% respectively.

The results of multiple regression analysis revealed that The R^2 value was 0.97. This implies that 97% of the variation in the adoption rice production practices was due to the independent variables considered in the model. The estimated coefficient (0.092) of age was positive and significantly influential to the adoption of rice production practices. The estimated parameter for sex was positive and significant at 1% level of probability. This indicates that sex is proportionally related to the adoption of recommended rice production practices. Education was positive and significant at 1% level of probability. The positive coefficient of educational status means that there is a direct relationship between adoption of recommended rice production practices and educational status, whereby as educational status increases, adoption level also increases among farmers. The coefficient (0.161) obtained for extension contact was positive and significant at 1% level of probability. This suggests that adoption of recommended rice production practices by farmers in the study area increased as contact with the extension agents and farmers become more frequent. The coefficient (0.477) for membership of associations was positive and significant at 1% level of probability.

The major constraints faced by the participants of Tugan-Kawo irrigation projects were capital and this was ranked first among the constraints, limited irrigated land which was ranked second followed by problem of pests and diseases. About 93% of the respondents reported outbreak of pests and diseases. Quilea birds invasion was also found among the major constraints faced by the participants and this was ranked fourth amount the constraints faced by the respondents.

5.2 Conclusion

The findings of the study reveals that the farmers in the study area were in their active age and therefore, are within agricultural productive age range. The participants and non-participants had family size of 7 and 5 persons respectively, therefore, the farmers in the study area had fairly large family labour availability for agricultural production. The study also shows that majority of the participants were more educated than the participants. The level of education of participants could influence the level of adoption of recommended rice production practices. The participants were members of cooperative societies. Membership of cooperative societies enhanced accessibility to credit, farm inputs and information on how to improve farming activities. The average farm size indicates that the participants were small-holder rice farmers with less than one hectare dominated irrigation farming in the study area. This indicates that farmers in the area operate at a small scale production level and family members contribute the required labour.

The findings reveal that the participants rice output, rice yield, income and level of living of the participants were significantly higher than the non-participants. This implies that the participants had more household basic needs and assets, means of transportation, farm implements, which reduce drudgery in farming.

Factors such as age, gender, education, extension contact and membership of association were found to influence adoption of recommended rice production practices in Tunga-Kawo irrigation project.

The major constraints faced by participant of Tugan-Kawo irrigation project were inadequate capital, quila bird invasion, inadequate irrigated land, high cost of

maintenance, flooding, pest and diseases. These constraints might have reduced the positive impact of the project on the participants.

5.3 Contributions to Knowledge

The contributions of this study to the body of knowledge are:

i. The work has been able to bring out the socio-economic characteristics of rice farmers in Tungan-Kawo Irrigation project.

ii. The work has also been able to show the level of adoption of recommended rice production practices by irrigation farmers in the study area.

iii. The work has shown the impact of the project on rice production, income and level of living of the people.

iv. This research work has been able to identify the constraints encountered in the implementation of irrigation project in the study area, and this has contributed in the understanding of the general problems of implementing irrigation projects in Nigeria.

5.4 Recommendations

Based on the findings of the study, the following recommendations are made:

(i) Inadequate capital was the major problems encountered by the participants of Tungan-Kawo project. It is recommended that the project should increase her soft loan given to the farmers.

(ii) Inadequate funding was the major constraints in the implementation process. Government and non-governmental agencies should always collaborate in the implementation of agriculture based programmes to put enough funding together for the implementation of agricultural programme.

(iii) Inadequate cooperation from the participants was observed as one of the constraints faced by the management in the implementation of Tunga-Kawo dam irrigation project therefore, participating farmers should be encouraged to cooperate with the management in the implementation of the project in order to achieve the stated objectives.

(iv) In order to address the problem of high cost of operation and maintenance facing the participating farmers, government should subsidize farmers' inputs such as fertilizer, agro-chemicals, irrigation facilities.

(v) It was revealed from the findings that the project had a positive influence on the output, income and level of living of the participants therefore it is recommended that a similar programme should continue to be implemented in the area after the implementation of Tugan-Kawo irrigation project.

(vi) Education was positively and significantly influential to adoption of recommended rice production practice implementation of Tugan-Kawo irrigation project and similar projects should involve an integrated approach that promotes education among farm households.

5.5 Suggestions for Further Research

i. Comparative studies should be conducted to find out the difference in yields between improved rice production practices and traditional practices in the study area.

ii. Evaluate the factors influencing the level of farmers' participation in irrigated rice production practices in the study area.

iii. Assess the factors influencing the rate of adoption of recommended rice production practices.

iv. Study should be conducted on the development and adaptation of small farm machinery for harvest and post-harvest operation in rice production.

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APPENDIX I: RESEARCH QUESTIONNAIRE FOR FARMERS

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

RESEARCH QUESTIONNAIRE FOR FARMERS

INSTRUCTION: This questionnaire is for research purpose only, kindly tick or fill in the appropriate spaces provided.

A: BACKGROUND INFORMATION

1. Name of respondent _____
2. Name of village _____
3. Participant _____
4. Non-participant_____

SECTION B: SOCIO-ECONOMIC CHARACTERISTICS

5. Age _____
6. Gender: a. Male [ ] b. Female [ ]
7. Marital Status" a. Single [ ] b. Married [ ] c. Divorced [ ] d. Widowed [ ]
8. Indicate the members of your household as follows: a. wife(ves) [ ] b. male 18 years and above [ ] c. male between 12-17 years [ ] d. female 18 years and above [ ] e. female between 12-17 years [ ] f. children under 12 years [ ]
9. Educational Qualification: a. no formal education yes [ ] No [ ] b. Qur'anic education [ ] c. Adult education [ ] d. primary education [ ] e. secondary education [ ] f. Tertiary education [ ] g. Others (specify)_____
10. Major occupation of the respondent: a. farming [ ] b. craftworks [ ] c. Animal husbandry [ ] d. Trading [ ] e. Civil servant [ ]

    f. Others (specify)_____

11. How long have you been living in the village?_____ years?
12. How long have you been practicing irrigation farming under Tungan Kawo irrigation project ? _____ years
13. How many hectares of land do you cultivate_____?
14. What is the tenancy status of plot(s) cultivated? a. inheritance [ ]
    b. purchase [ ] c. Government allocation [ ] d. gift [ ] e. lease [ ]
    f. Others (specify)_____
15. How far is the irrigation project from your village? _____kilometers
16. Do you have contact with extension agent? Yes [ ] No [ ]
17. If yes, how many times have you had contact with agent from 2005-2011?__
18. Have you benefited from your contact with the extension agents? Yes [ ] No[ ]
19. If no, give reasons_____
    _____
    _____
20. Are you a member of any farmer association? Yes [ ] No [ ]
21. If yes, how many association do you have? _____ association
22. How many associations do your belong?_____ associations
23. For how long _____ years
24. Have you obtained any credit in the past five years? Yes [ ] No [ ]
25. If yes, state the source and the amount: a. commercial banks ₦_____
    b. microfinance banks ₦_____ c. co-operative societies ₦_____ d. friends and relatives ₦_____ e. money lenders ₦_____ f. Others (specify)

SECTION C: LEVEL OF ADOPTION OF RECOMMENDED RICE PRODUCTION PRACTICES

26. Do you plant any improved rice varieties? Yes [ ] No [ ]
27. What type of rice varieties do you plant
    a. FARO [ ]
    b. NERICA [ ]
    c. WITA [ ]
28. If no, why?_____

29. Which of the following rice production practices have you adopted:

SN	Practices	Awareness		Adopted	
		Yes	No	Yes	No
A	Improved rice varieties i. FARO ii. NERICA iii WITA				
B	Planting dates i. May-July ii July-August iii Others (specify)_____				
C	Plant spacing i. 1.00 cm ii. 1.5 cm iii. 2.0 cm Others (specify)_____				
D	Planting depths i. 30 x 30 cm ii. 25 x 25 cm iii. 20 x 20 cm Others(specify)_____				
E	Recommended fertilizers i. NPK (100kg/ha) ii. SSP (188kg/ha) iii. Urea (200kg/ha) iv. Othersspecify)_____				
F	Weed control i. Propanil + Bentazon ii. Propanil + Flurodifen iii. Propanil + 24D [ ] iv. Oxadiazon				

	v. Butachlor vi. Pendimettalin Others (specify)_____				
G	Harvesting method i. Use of sickle ii. Use of knife iii. Others (specify)_____				

30. Are you satisfy with the recommended rice production practices? Yes [ ] No [ ]
31. What influenced the adoption of the above named recommended rice production practice?
    a. High yield
    b. High market value
    c. Early maturity
    d. Low cost
    e. Others (specify)_____
    a. _____
    _____
    b. _____
    _____
32. What are the sources of labour for rice cultivation? a. family labour [ ] b. hired labour [ ]
    c. cooperatives labour [ ] d. all of the above e. Other (specify)_____
33. How much of your land is irrigated by water from the dam? a. all [ ]
    b. half [ ] c. a little plot [ ]
34. Does the water satisfy your needs during cropping season? Yes [ ] No [ ]
35. Do you have regular water supply? Yes [ ] No [ ]
36. Do you pay for irrigating your plot(s)? yes [ ] No [ ]
37. Are you satisfied with the payment? Yes [ ] No [ ]
38. Please tick in the table below based on the information provided:

1. RA: Readily available
   FA: Fairly available
   NA: Not available

2. RA: Readily accessible
   FA Fairly accessible
   NA: Not accessible

	Availability				Accessibility		
	RA	**FA**	**NA**		**RA**	**FA**	**NA**
a. Tractor hiring scheme							
b. Subsidies on inputs							
c. Access to farm inputs e.g. fertilizers,							
improved seeds, herbicides							
d. Irrigation water e. Irrigation pumps							
f. Information on new practices							
g. Financial assistance (credit)							
h. Storage facilities							
i. Portable water							
j. Meetings							
k. Access roads							
l. Health facilities							
m. Provision of education facilities							
n. Provision of drinking water							
o. Access to market for produce							

39. In what ways do you normally obtain these services for the project activities?

_____

_____

_____

40. What is the total amount received as credit from the Tungan-kawo irrigation project scheme?_____ Naira

41. What is the total amount received as subsidies from the Tungan-kawo irrigation project scheme _____ Naira

42. Is there available market for your rice ? Yes [ ] No [ ]

43. How do you market your produce? a. Open village market [ ] b. Retailers [ ]

c. Wholesalers [ ] d. All of the above [ ] e. Farm gate [ ]

e. Others (specify)_____

44. From the above alternatives are you satisfied with the marketing system? Yes [ ] No [ ]

45. How would you assess your relationship with neighbouring farmers?

a. Satisfactory [ ] b. No Satisfactory [ ]

SECTION D: IMPACT OF TUNGAN-KAWO PROJECT

46. Tick the appropriate space

	Project Participants	Project Non-participants
How many hectares of land did you cultivate 2011?		
What was the quantity of rice harvested from the area of land cultivated(100kg bag/ha) in 2011?		
How much does it cost you to produce rice harvested from the area cultivated (Naira)?		
How much did it cost you to process and transport the produce from the area cultivated (Naira)?		

47 What is the total amount spent in the household per month on the following after the implementation of Tungan-kawo Irrigation project?

SN	Household activities	Project participants	Project non-participants
1	Children's education		
2	Health		
3	Feeding		
4	Clothing		
5	Light bill		
6	Energy		
7	Entertainment		
8	Others (specify)		

48. Indicate the assets you have after Tungan-kawo Irrigation Project

	Project participants			Project non-participants		
Assets	**Number/type**	**Unit/ Price**	**Total Value**	**Number/ type**	**Unit/ Price**	**Total Value**
a. Electrical durables: Refrigerator						
Deep freezer						
Cooker						
Grinding machine						
Others (specify)						
b. Electronics:						
Radio						
Video						
Television						
Mobile phones						
Video CD						
Rechargeable lamp						
Satellite						
Others (specify)						
c. Farm animals:						
Cattle						
Sheep						
Goat Poultry						
Others (specify)						
d. Farm equipments: Tractors						
Pumping machine						
Dryer						
Wheel barrows						
Hoes Machetes/cutlasses						
Sprayer						
Axes						
Others (specify)						

e. Vehicles/Automobiles:						
Motor Car						
Bus/Lorry						
Motorcycle						
Bicycle						
Others (specify)						
f. Buildings:						
g. Others (specify)						
Total (Naira)						

48. What benefits do you derive from Tungan-kawo Irrigation project:

a. Access Roads [ ]
b. Storage facilities
c. Easy access to market [ ]
d. Electricity [ ]
e. Access to extension services [ ]
f. School [ ]
g. Health care services [ ]
h. Good drinking water [ ]
i. Recreation [ ]
j. Communication network [ ]
k. Others (Specify)_____

49. What employment opportunities do you think Tungan-kawo irrigation project has brought in the area?

a. Trading [ ]
b. Craftwork [ ]
c. Fishing [ ]
d. Bricklaying [ ]
e. Transportation [ ]
f. Hired farm labour [ ]
g. Repairs of pump machines [ ]
h. Sales of spare parts [ ]
i. Others (specify)_____

SECTION E: CONSTRAINTS IN THE IMPLEMENTATION OF PROJECT ACTIVATES

50. Was there any displacement of properties in the area as a result of the project?

Yes [ ] No [ ]

51If yes, what property were displaced? _____

52 Has there been any environmental degradation as a result of project activities?

Yes [ ] No [ ]

53 If yes what is the degree of occurrences?

	Frequently	Less frequently	Rarely
a. Siltation			
b. Erosion			
c. Weed infestation			
d. Flooding			
e. Deforestation			
f. Others (specify)_____			

54. What do you think is responsible for these environmental problems?

a. Excessive use of fertilizers/manure [ ]
b. Excessive use of chemicals [ ]
c. Excessive use of farm machines [ ]
d. Others (specify)_____

55. Do you have problem with irrigating your plots due to the incidences above?

Yes [ ] No [ ]

56. What is the prevalence of the following in the Tungan-kawo irrigation project?

Constraints	Frequent	Less frequent	Rarely
a. Quilea bird invasion			
b. Inadequate irrigated land			
c. High cost of operation and maintenance			

d. Pest and diseases			
e. Malaria			
f. Flooding			
g. Others (specify)			

57. What other problems do farmers encounter in the Tungan-kawo irrigation project apart from the ones mentioned above?

_____

_____

58. What general suggestions can you give to improve irrigation farming in Tungan-kawo project?

_____

_____

_____

APPENDIX II: QUESTIONNAIRE FOR THE MANAGEMENT

DEPARTMENT OF AGRICULTURE ECONOMIC RURAL SOCIOLOGY,
FACULTY OF AGRICULTURE
AHMADU BELLO UNIVERSITY ZARIA,

MANAGEMENT OF TUGAN-KAWO DAM IRRIGATION PROJECT RESEARC QUESTIONAIRE

1. Name of respondent
2. Qualification
3. Status
4. Do the participation of Tungan-Kawo irrigation project have access to any form of assistance other than the irrigated lands yes [ ] no [ ]
5. If yes, mention them----------
6. Are the participants charged for the irrigated services yes [ ] no [ ]
7. Are the participants charged for the irrigated lands yes [ ] no [ ]
8. I yes, how much per hectare? ----------
9. How would you access the performance of the participants of Tungan-Kawo irrigation projects?
10. Very satisfactory [ ] satisfactory [ ] less satisfactory [ ] not satisfactory
11. What is the prevalence of the following in Tungan-Kawo irrigation project?

	Frequently	Last frequent
a. Quilea bird invasion Rarely		
b. Inadequate irrigated land		
c. High cost of operation and maintenance		
d. Pest and disease		
e. Malaria		
f. Flooding		
g. other (specify)		

12. Was there any form of displacement of families living in the area as a result of the project?

13. If yes, were they compensated?

14. What other problems does the management encounter in the implementation of Tungan-Kawo irrigation project apart from the one mentioned above?----------
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15. What general suggestion can you give to improve irrigation farming in Tungan-Kawo project?----------
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