IMPACT OF TUNGAN-KAWO IRRIGATION SCHEME ON RICE PRODUCTION IN WUSHISHI LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA

BY

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MTech/SPS/2017/7263

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A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY MINNA NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF TECHNOLOGY IN GEOGRAPHY (ENVIRONMENTAL MANAGEMENT)

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ABSTRACT

The study seeks to examine the impact of Tungan-kawo irrigation scheme on rice production in Wushishi Local Government Area, Niger state, Nigeria. Yamane formula was used to deduce 400 farmers/respondents from the population of the study whose response were collected through interview and copies of structured questionnaire plus field survey conducted utilizing a purposive sampling technique. The data were subjected to statistical analysis which include descriptive statistics of frequency count and percentage while the Pearson's product-moment correlation coefficient of multiple regression analysis was utilized in measuring the impact of the rice irrigation scheme on living strategies of farmers within the study area. From a response rate of 91.75%, 66.8% of the farmers were within the age range of 18 to 38 years. This portends an indication that there is opportunity for more active years in not only rice production but agricultural practices generally. The study revealed the ratio of male to female where, 93% of respondents were male while the marital status observed indicated that 92.1% were married. The level of educational qualification of respondents was highly appreciated as a substantial number of them have formal education, where 52.9% have tertiary education. It also revealed that 87.5% practice farming majorly, where farmers' average experience in paddy rice production was recorded to be 11 to 20 years while farmland cultivated was substantially through inheritance and rentage with an average farm size of 5 acres. Within the demographic characteristics of farmers, 70.0% of respondents had household size of 6 to 10 persons. It was also recorded that 62% of farmers harvested their rice field thrice annually with most of them (65.1%) cultivating 4 to 7MT/acre. 67.6% of the farmers reported to had enlightenment visitation of four times and above annually from Agricultural extension workers while 65.1% rake-in an estimated income of ₦1,000,000 to ₦2,000,000 per annum. However, the vulnerability level of rice field measured suggested that majority of the farmers constituting 65.9% were within the group "moderate level". The study further made a comparative estimate of paddy rice produced within the period of 1993 to 2018 from both irrigation system and rain-fed system, and a moderate positive correlation was established between rice irrigation farming and living strategies of farmers. The application of fertilizer and improved seedlings were majorly adopted by all the farmers. It is recommended that sustainable management of farm infrastructure and facilities be practice and patronization of domestically produced rice be encouraged.

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ABBREVIATIONS

AEZ- Agro Ecological Zone

AU- African Union

CAADP- Comprehensive African Agriculture Development Programme

CBN- Central Bank of Nigeria

FAO- Food Agricultural Organization 5

FAOSTAT- Food Agricultural Organization Statistic

FGN- Federal Government of Nigeria

FMARD- Federal Ministry of Agriculture and Rural Development

GDP- Gross Domestic Product

GIS- Geographic Information System

GPS- Global Positioning System

HA/ha- Hectares

IFAD- International Fund for Agricultural Development

IGAD- Inter Governmental Authority on Development

IPCC- Intergovernmental Panel on Climate Change

IRRI- International Rice Research Institute

Km- Kilometre

LGA- Local Government Area

MT/mt- Metric Tonnes

NSBS- Niger State Bureau of Statistics

NEPAD- New partnership for Africa's Development

NERICA- New Rice for Africa

NIFFR- National Institute for Freshwater and Fisheries Research

NINCID- Nigeria National Committee on Irrigation and Drainage

NPopC- National Population Commission

NTA- Nigerian Television Authority

RBDAs- River Basin Development Authorities

RGEs- Rice Growing Environments

RIFAN- Rice Farmers Association of Nigeria

SSA- Sub Saharan Africa

UN- United Nation

UNRBDA- Upper Niger River Basin Development Authority

URS- Upland Rice System

VCD- Value Chain Development

WARDA- West African Rice Development Agency

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

It is reported that Africa, as a continent has the capacity to irrigate 42.5 million hectares (ha) based on available resources (land and water) and by far the greatest potential acknowledged by Lebdi (2016) is found in Nigeria, which accounts for more than 2.5 million hectares for both subsistence and commercial agriculture.

In a related development, Nigeria ranked 69th amongst countries by irrigated land area with only about 293,000ha of irrigable land equipped for irrigation, yet only about 218,000ha is actually irrigated with about 173,000ha under private small scale while, 29,000ha is under public irrigation scheme (World Bank, 2016). The nation is the most populous country in Africa and the seventh most populous in the world with ample acreage adjudged to be the best in term of fertility and appropriateness for agronomic practices (Folorunso, 2008).

Irrigation is an integral part of agricultural activities in Nigeria and its utilization recently, has improved tremendously throughout the country, although on a slow pace, which informed the motives why it is yet to play a substantive role to curtail the disparity between food demand and supply, to benefit farmers and generate jobs for the teeming youth in particular.

The rice sector in the country is one of the most remarkable agronomic developments over the decades because it is the most consumed staple food by Nigeria's over 174 million people across states and geo-political regions as acknowledged by Terwase and Madu (2014). Also, it remains the grain irrigated predominantly in the country especially in dry seasons.

In view of this, Ugalahi *et al*. (2016), noted that consumption of rice in the country was abated by natural and socioeconomic phenomena, which include; population growth, increase in urbanization, and changes in dietary need. Against this backdrop, Nigeria resolved to the importation of rice on an unprecedented rate in order to balance the disparity, a situation that crippled local production and negatively affected the economy. It is to achieve self-reliance and boost the economy that the Federal Government of Nigeria (FGN) initiated various agricultural programmes including the "Rice Revolution".

In 2018, the Nigeria Television Authority (NTA) broadcasted that the country was spending not less than U.S $ 5 million per day, a situation that aggravated the negativity in the rice sector, thus undermining the general outlook of the economy. The FGN decision to ban the importation of rice was a step in the right direction which brought a turn-around in the local production of rice, as over 12 million farmers are producing more than 18 million tonnes of rice across the country. Also, output per hectare has increased from 1tonne to 5 and 7 tonnes per hectare depending on the location.

Nigeria is keenly encouraging domestic production where the state of Niger, endowed with fertile land (Folorunso, 2008) especially along the floodplains of rivers Kaduna and Niger and other rivers that traverse the state has stepped up its effort in this regard. Those communities that are situated along the river banks (for example, Tungan-kawo, Badeggi, Jebba, Katcha, Swashi, Lokogoma, and Zungeru) produce rice in both dry and rainy season while those that are situated upland produce only during the rainy season.

As such, rice production in the State has appreciated progressively following the rice revolution initiative. Recent documents revealed that the state of Niger is amongst the six major rice producers in the country, producing between 1.4 and 2 million tonnes each in both wet and dry season (BBC News, 2018). Therefore, the study seeks to determine the contribution of Tungan–kawo irrigation scheme towards the state and national production in curtailing the trend of rice importation and attaining self-sufficiency in the commodity.

1.2 Statement of the Research Problem

Experts are of the opinion that to assure food security in the rice consuming countries of the world including Nigeria, rice production will have to be redoubled by 50% in the affected nations by 2025 as reported by Zeng *et al.* (2004) cited by Makusidi, (2015) and this increment will have to be achieved on less land, with less usage of water, labour and chemicals.

Under this premise, food and in particular rice consumption within the country is increasing in volume due mainly to socioeconomic phenomena. This appeal for more agricultural production per capita per year by 2025 to mitigate the imbalance between production and demand, and sustainable irrigation culture will be an important mechanism to curb this disparity.

The Government of Nigeria in a deliberate attempt to enhance rice production and food security generally, established various irrigation schemes across the country of which Tungan-kawo irrigation scheme is one of them. The development of sustainable irrigation practices in the country cannot be over emphasized considering present population growth rate of 3.2% annually, while food production is increasing by only 2.5% per annum.

This notion conforms to recent statistics reeled out by the United Nations (UN) Food Agricultural Organization (FAO, 2015) which indicated that by the year 2025, it will be difficult for Nigeria to feed her populace if alternative farming systems, such as irrigation are not fully harnessed.

And with the current policy of the Federal Government tagged “Rice Transformation Agenda” of which the Agricultural Production Policy was built upon, rice production has sprung up immensely and several activities are now undertaken at the scheme.

The study was conducted to examine the magnitude of the contribution of Tungan-kawo irrigation scheme to the economy of Nigeria, Niger state and the local economy of Wushishi through the provision of jobs and enhancement of food security.

1.3 Justification for the Study

The study seeks to highlight the various activities involved in rice irrigation farming at Tungan-kawo irrigation scheme in Wushishi, Niger state, Nigeria. And how the government policy on rice production has motivated the citizens and businesses to embrace sustainable rice irrigation culture.

This research also seeks to contribute to the body of literature for students and scholars and especially those interested in irrigation practices especially rice irrigation farming as exercised in Tungan-kawo.

The study will assist the government in taking appropriate measures towards improving the irrigation scheme and other similar irrigation projects so as to help in its determination to attain self-sufficiency in rice production.

While some research delves at irrigation cultivation of fruits, vegetable and wheat, this study focused on rice irrigation farming so as to measure the tremendous effect on households partaking in rice production and its value added chain.

1.4 Scope and Limitation of the Study

The study encompasses the impact of Tungan-kawo irrigation scheme on rice production in Wushishi L.G.A, Niger state, Nigeria. The scheme serves Bankogi, Dankuwagi, Kanko, Kasakogi, Kodo/Yelwa and Maito communities. It further covers the impact associated with the irrigation scheme couple with the degree of vulnerability of the irrigation scheme and the strategies adopted by farmers for optimal productivity within the study area.

However, the study was limited to rice irrigation farming within Tungan-kawo irrigation scheme, Wushishi L.G.A, Niger state of Nigeria.

1.5 Aim and Objectives

The main aim of the study is to assess the impact of Tungan-Kawo irrigation scheme on rice production in Wushishi L.G.A, Niger state, Nigeria.

The specific objectives include to:

i. identify the irrigation activities of rice production in the study area;

ii. examine the impact of rice irrigation farming on livelihood of the communities in the study area;

iii. examine the degree of vulnerability of the rice irrigation scheme;

iv. assess the strategies adopted to improve productivity.

1.6 Research Questions

The thesis seeks to answer the following questions:

i. What are the activities of rice irrigation production in the study area?

ii. What are the impact of rice irrigation farming on livelihood of the communities in the study area?

iii. What is the degree of vulnerability of rice irrigation scheme in the study area?

iv. What are the strategies adopted to improve productivity within the study area?

1.7 The Study Area

Geographically, Wushishi L.G.A is situated in Niger state of Nigeria. Wushishi has an area of 1,879.4km². It has a population of 81,783 (National Population Commission, (NPC), 2006) and the postal code of the area is 922. The Bureau of statistic has maintained an approximate population growth rate of 3.2% geometrically. Hence, the projected population was estimated to be 119,349 as at 2018. The study area lies between Latitudes 8° 22’ N and 11° 30’N and between Longitudes 3°30’and 7° 20’E. It is situated along River Kaduna and surrounded by mountains, giving it a lower elevation than the surrounding topography. It shares boundaries with Bosso L.G.A to the West, Rafi to the South, Mashegu to the East and to the North by Mariga. The L.G.A is the site of Tungan kawo irrigation dam, Niger state Polytechnic and Zungeru Hydro-electric dam.

Tungan-kawo irrigation scheme is situated at approximately 7 Km away from Wushishi town, Wushishi L.G.A of Niger state. The scheme lies between Latitudes 9° 48’ and 9° 59’N and between Longitudes 6° 45’E. The site is highly traversed and well accessible

and it is naturally a *fadama* land situated within the floodplains of Rivers Ubandawaki and Bankogi where the Tungan-kawo dam is housed.

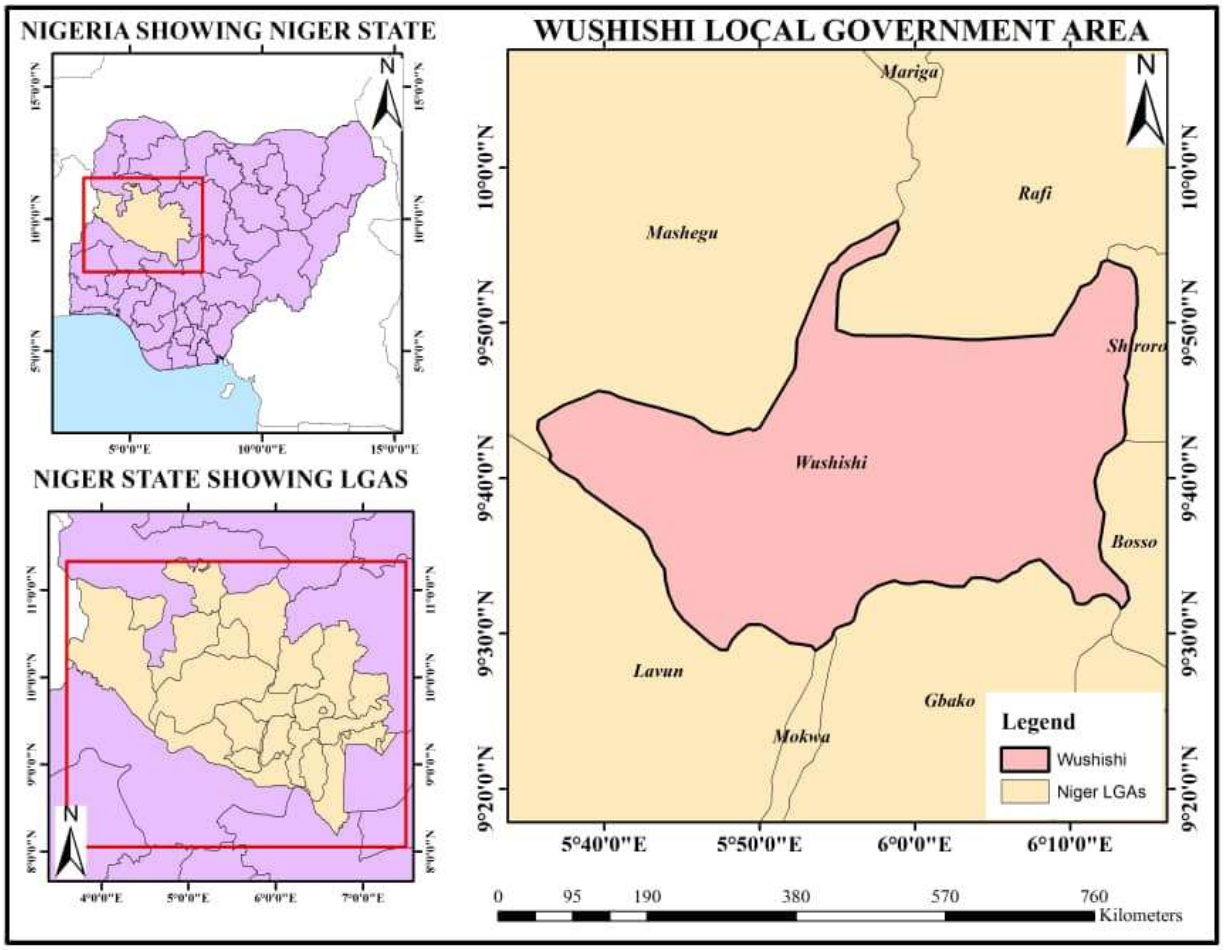

Figure 1.1: Nigeria highlighting Niger state and Wushishi L.G.A.
Source: Author's work, (2019).

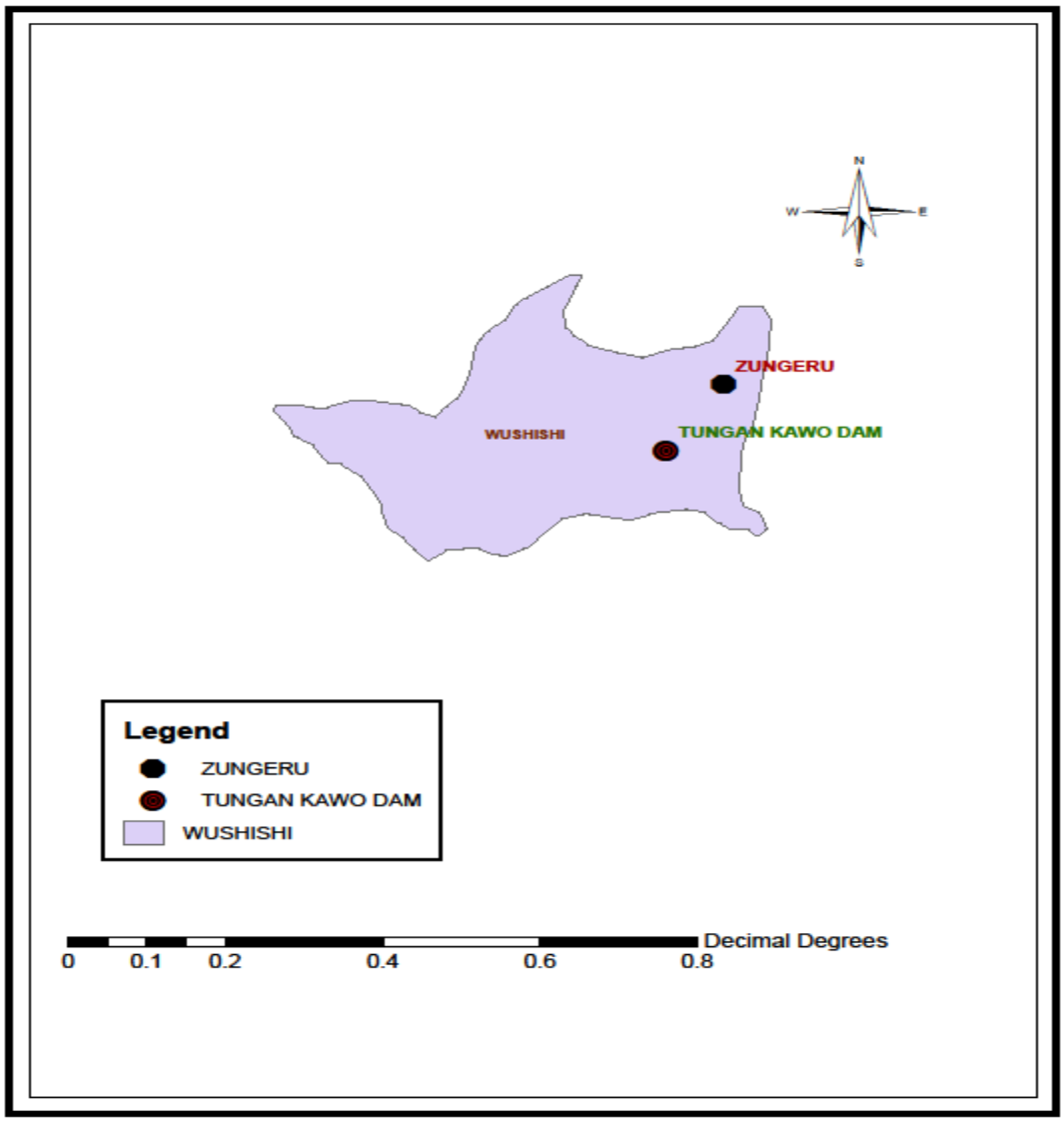

Figure 1.2: Wushishi L.G.A depicting Tungan-kawo irrigation scheme

Source: Author's work, (2019).

1.7.2 Climate

There are prominent climatic features which are vital in agricultural practices and particularly, rice production. These are rainfall, temperature and humidity. These climatic variables combined with the area's physiography and altitude have essential influence on rice production.

Wushishi L.G.A is generally tropical with marked seasonal and altitudinal temperature with dry and rainy seasons. The rainy seasons starts from April till October while the dry seasons begin from November to March. It experiences a mean annual rainfall of 1302mm with September measuring the highest down pour yet of 300mm. The mean monthly temperature is high in March at 30.50°C (85°F) and low in August at 22.3°C (72°F). The average monthly minimum and maximum temperatures observed in the study area were 20.5˚C and 35.5˚C respectively (Niger State Facts and Figures, 2012).

The mean relative humidity in Wushishi is estimated to be within 60% in January to February, and 80% from June to September because it experiences extreme seasonal variation in humidity. Unlike temperature which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically trailed by a muggy night and this humid period of the year lasts for 9 months, from February 21 to November 22 (Niger State Facts and Figures, 2012).

1.7.3 Soil

The soil of the irrigation scheme is derived primarily from the floodplain of River Ubandawaki and Bankogi where the topography is significantly flat and low-lying. Highly eroded or gully surfaces are observed around the flood embankment and few of the access roads (Upper Niger River Basin Development Authority (UNRBDA), 2011).

Soil texture within the scheme vary from sand to sandy-loam in upland area, though moderately well drained. Whereas, the *Fadama* parts vary from sandy-loam to loam, sandy-clay-loam and clay and it is poorly drained.

The soil composition of sandy-loam and loam texture bring about the best products in irrigation practices because of its high permeability and moderate water holding capacity. While sandy-clay, loam and clay composite exhibits poor permeability resulting to shallow root growth, poor aeration, low microbial activities, water logging and consequently high water holding capacity (UNRBDA, 2011).

The structure of any agricultural soil is a very significant property for aeration, infiltration, water percolation and retention, drainage and the growth of plant roots. A substantial part of the irrigation scheme comprises of soil structures that ranges from medium, angular, blocky and crumb structure in the upland to coarse, angular, blocky structure in the *Fadama* section of the scheme. All these soil structure observed are adjudged to be suitable for rice and other crops cultivated within the scheme. The soil can be categorized under the major soil group order of Inceptisols (United States Department of Agriculture) derived from alluvial deposits and the interphase of the Nupe sandstone and basement complex (UNRBDA, 2011).

1.7.4 Drainage pattern/system

The irrigation scheme being situated within the floodplains is largely low-lying and characterized by pockets of depression (ponds/lakes) all abound the scheme, some of which contained water during field/reconnaissance survey conducted. However, the existing drainage pattern shows that the area is naturally drained into River Bankogi located towards the downstream of the scheme which further drain into River Kaduna (UNRBDA, 2011).

1.7.5 Socio economic activities

The economic activities of this area are vested in the production of agricultural products. The people of Wushishi are predominantly farmers. Although, few engage in fishing and small-scale businesses for their livelihood, rice cultivation is widely practice in the area. Economic activities of this area are discussed herewith:

Farming activities – due to the soil texture, climate and physiographic features of the study area, the cultivation of Grains (for example; maize, guinea corn, millet, beans, sesame seed, rice), Tuber crops (for example; yam, cassava and sweet potatoes), Fruits (for example; mango, cashew, guava, shea butter and water melon) and Vegetables (for example; garden egg, tomatoes, pepper and bitter leaves) are practiced.
Fishing activities – fishing has also been observed to be one of their mainstays and a source of income for the people. Such activity is possible due to the presence of River Kaduna and other rivers like Bankogi and Ubandawaki that cut across the area bringing along with it varieties of fish such as catfish and tilapia.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Literature Review

Literature reveals that application of water to the soil profile which serve as the root zone is termed irrigation, while the irrigation systems that are efficiently managed are those that regulate the spatial and temporal supply of water so as to promote growth and yield, and to enhance the economic proficiency of crop production (Balarane and Oladele, 2014).

Reports also verified that total arable land and food production have remarkably been upgraded through irrigation practices. Statistics have shown that about 8.1 million hectares totaling 20 million acres approximately used to be under irrigation as at 1800, a figure that rose to 41 million hectares (99 million acres) in 1900. Irrigated land area increase to 105 million hectares (260 million acres) in 1950, and to more than 273 million hectares (675 million acres) today. Irrigated land globally represents about 18% of all land under cultivation but often produces over twice the yield of non-irrigated fields (University of Arkansas, 2015).

Report of Africa's Progress (2015), asserted that agribusiness and consequently food production accounts for two-thirds of livelihoods and poor people's household budget. This emphasizes that agriculture is one of the prominent social and economic segment in the continent. The consequence is that improved people's wellbeing in the continent depend mostly on the performance of agriculture and its related practices.

In a paper written by Lebdi, for African Transformation Report (2016): titled "Transforming Africa's Agriculture", irrigation is one main sector identified by the Comprehensive African Agriculture Development Programme (CAADP) under the New Partnership for Africa's Development (NEPAD), whose implementation is expressed through the CAADP Compact Process for every country, corroborated by governments and civil society organizations and sustained by technical and financial establishments. The report noted that, African Union (AU) has established an initiative tagged "African Water Vision 2025" which pegged irrigation as a key component for equitability and sustainability of water usage for socio-economic enhancement of its populace (for example, food production).

2.2 Irrigation system in Africa

Reports had it that on the average, irrigation occupies 0.27 ha of cultivated area per inhabitant in Africa (0.24 ha for average in the world) and 1.02 ha per economic active person contributed in agricultural related practices in the continent in contrast to 1.16 ha for the average in the world. These figures should be compared and contrasted by taking into consideration the population growth and the economically active population

participating in agriculture. As such, the advancement of irrigation system is not only necessary but pertinent for the security of its populace (AGENDA '2063', 2018).

The assessment of surge in population within the continent and the world portrayed by University of Arkansas (2015), opined that the rate of population growth in the continent is relatively high (2.2% per year) when the average in the world is just under 1.2% annually. This infers that the pressure on agriculture, particularly irrigation is higher in the continent and subsequently in the future. This is so because the A.U is pursuing all alternatives in order to ensure food security and nutrition to the teeming population.

The same comment is binding if we are to examine the rate of economically dynamic persons involved in agriculture, where it was estimated to be 56% against 21% average in the world. Moreover, this is a window of opportunity for agricultural transformation if alternatives on investment in irrigation are created judiciously to optimize production and generate employment for the active agricultural population (Ajah and Ajah, 2014).

2.2.1 Impact of irrigation enhancement

In time memorial, agronomic practices have been aided by the utilization of irrigation in serving growing populace and is indisputably destined to perform a phenomenal role for posterity. It not only raises the yield of specific crops (for example, grains and vegetables), but also prolongs the effective crop growing stages in areas with dry land features, thus permitting multiple harvesting (sometimes two or three and four crops annually) where a lone crop could be grown otherwise (Balarane and Oladele, 2014).

Apparently, irrigation practices across all region of the globe is perceived to contribute tremendously towards achieving food security, because supplementary inputs needed to intensify crop production further (for example, pesticides, fertilizers, improved varieties and better tillage) to become economically feasible are accomplished through the process.

Consequentially, the use of irrigation in rice production lessens the perils of these costly inputs being wasted by crop failure which could result from absence of water. In addition, other incredible benefits practically derived from the advancement and utilization of water resources in agricultural practices through irrigation development entail; social, demographical, public services and fiscal impacts as recounted by Kirsten and Van Zyl (n.d).

2.2.2 Harnessing irrigation in Nigeria

Ugalahi *et al.* (2016), investigation claimed that irrigation practices in Nigeria started as far back as the 19th century, when the country was colonized but became profound after independence (precisely after the famine of 1970 to 1975). The necessity for optimal cultivation to alleviate suffering which could result from food shortage led to emphasis on irrigation system. In the beginning, irrigation system was dominated by traditional procedures which embodies; *Fadama*, gravity or natural flow, calabash/bucket/shadouf

and pump devices and these facilities were for the most part provided and maintained by small-scale farmers with neither assistance from government at the three tiers nor donor organizations.

As the relevance for crop cultivated through irrigation practices developed within the periods of 1972 and 1974, three model irrigation schemes were created for the populace, namely; Bakolori scheme, Kano river irrigation scheme and the Chad Basin scheme (Nigeria National Committee on Irrigation and Drainage (NINCID), 2015).

To this end, Ugalahi *et al.* (2016), alluded to the success of the model irrigation schemes recorded in mitigating the adverse effect of the early 1970s drought which further led to the insightful development of twelve River Basin Development Authorities (RBDAs) that cut across the length and breadth of the country. These RBDAs include: Benin-Owena Basin, Cross-River Basin, Hadejia-Jama'are, Maiduguri Basin, the Upper Benue Basin, Lake Chad Basin, Sokoto-Rima Basin, Yola Basin, Lower-Benue Basin, Ogun-Osun Basin, Anambra-Imo Basin and Niger Basin.

2.3 The production of rice in West Africa and World

Longtau (2009), in an assessment titled "Rice production in Nigeria" avers that rice is a major staple in global trade, rated third in crop produced worldwide (741.5 million tonnes in 2014), after sugar cane (1.9 billion tonnes) and maize (1.0 billion tonnes) (FAOSTAT, 2017). The commodity is predominantly cultivated throughout the tropics, and where flood control is effective such as in the South-east Asia where production of the crop is phenomenal. The bulk of the foreign rice imported into the West Africa sub-region is from the South-east region of Asia.

West Africa is the major consumer and producer of rice in SSA, as it is estimated to account for 61.9% and 64.2% of the total consumption and production respectively. The Niger River drainage system, however, is a chief rice growing environment (RGE) within the region (Longtau, 2009).

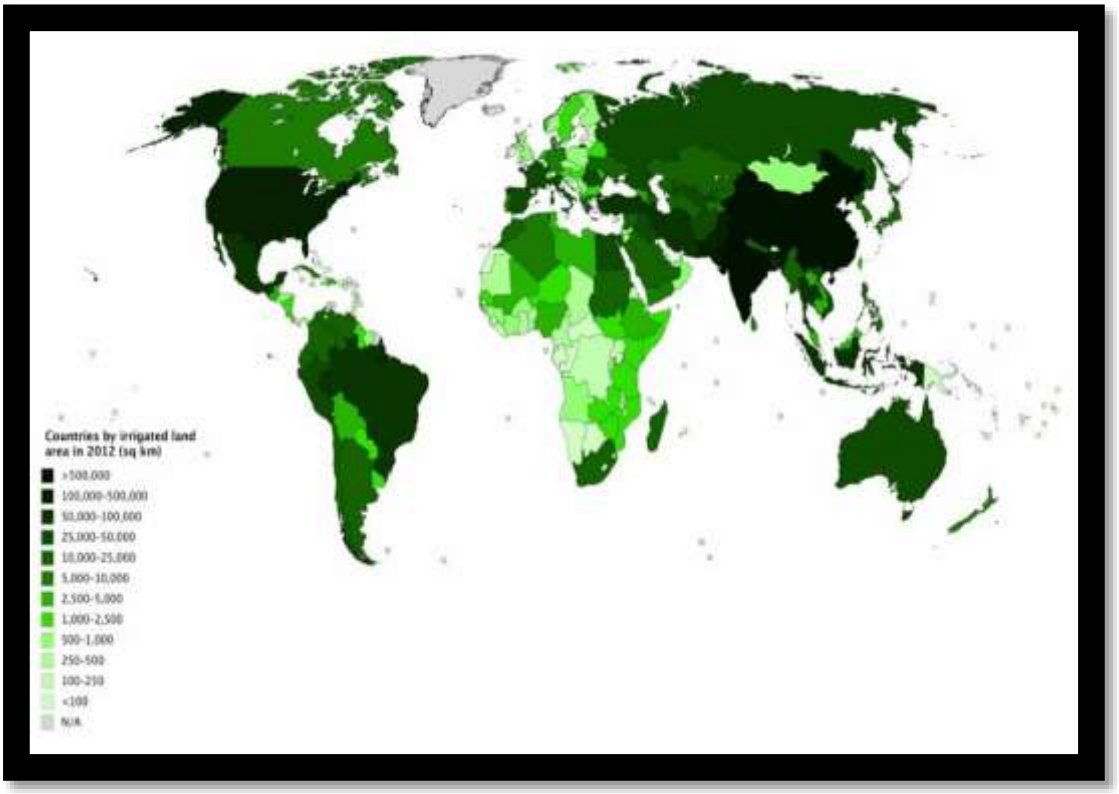

Figure 2.1: Countries by irrigated land area in 2012.

Source: World Bank fact book, (2016).

2.4 Rice cultivation in Nigeria

Nigeria ranked topmost in the production of rice in the sub-region and the crop is best grown on lands with moderately high water holding-capacity or simply put, marshy lands and these ecologies are practically found in the country. Dense and murky soils that can hold water are most desirable in the overall cultivation of rice (National Research Council, (2009).

Prominent varieties of rice grown in the country include; *Fadama* rice, *Ofada* rice, *Faro 44*, upland rice, lowland rice and *Faro* 52. Moreover, rice cultivation is well-situated in countries and regions with low labour costs and high rainfall including Nigeria, because it is labour-intensive to cultivate and requires ample water (National Research Council, 2009).

The production and consumption level of rice in the country remain substantial as it is the sixth major crop (grown on 1.77 million ha) cultivated after sorghum, millet, cowpea (beans), cassava and yam (Akinbile, 2010), yet the country relies on massive rice importation in order to bridge the supply gap, which in turn has constituted severe strain on the nation's foreign reserve and its attendant effect felt economically.

In furtherance to the resources expunged through the importation of rice, it was also verified that a lot of funds have been expended in the quest to enhance rice production in

the country. For instance, in the year 2000, U.S $ 66.67,000,000 was spent on irrigation schemes aimed at improving rice production (Nwalieji and Onwubaya, 2013). This is overwhelming because reports have indicated that staple such as rice, maize and wheat account for a greater share of the food demand in developing countries such as Nigeria.

Amongst the factors that have widen the gap in demand and supply of rice in the country include, lack of high yielding varieties with good grain qualities (low input), competition with imported rice and inadequate enriched practices (crop management techniques).

Other factors comprise of acreage degradation and inappropriate land preparation,

sporadic rainfall, problems with weeds, insects, birds, and insufficient training for the

farmers (DontsopNguezet *et al*. 2011) and (Makusidi, 2017).

2.4.1 Major varieties of rice in Nigeria

According to literature, three (3) types of rice were identified to be cultivated in Nigeria. These are the African rice, *Oryza glaberrima*; Asian rice, *Oryza sativa*; and West African Rice Development Association's (WARDA) hybrid rice, the New Rice for Africa (NERICA) available only to farmers under WARDA's programme.

For the Niger-Benue trough, Sokoto-Rima and Chad Basin, rice has been in cultivation long enough for a rice culture to have evolved (Longtau, 2009), spanning for about 5000 years ago. Hence, African rice is farmed either as a field crop and a paddy crop. Incredible deep-water varieties of *Oryza glaberrima* are observed within the Sokoto-Rima valley, floodplains of the extreme north of Nigeria as well as floodplains of the Benue trough and in the inland Niger Delta given its peculiarity (Longtau, 2009).

Table 2.1: Position of rice amongst major cereal crops and yield in tonnes.

Crops Produced (in Tonnes)	**1980**	**2000**	**2016**
Maize	612,000	4,107,000	764,678
Millet	612,000	4,107,000	764,678
Guinea corn	3,690,000	7,711,000	6,939,335
Rice	1,090,000	3,298,000	6,070,000
Sesame seed	15,000	72,000	460,988

Source: Adopted from FAOSTAT, (2018).

According to Rice Farmers Association of Nigeria (RIFAN), the rice revolution initiative has boosted Nigeria's paddy production from 2.5 million MT in 2015 to about 7 million MT in 2018.

2.4.2 Rice systems Agronomy and Geography

In rice cultivation, land types, soil properties, geographical and environmental factors accessible should be considered because not all rice varieties can be fruitful in every geographical zone. However, it is desirable at all times to aim for high-quality seeds which could profit the farmer through a bountiful harvest.

Significantly, the grain can be cultivated in diverse ecologies, reliant on much availability of water resources (IRRI, 2013). Though, its production could be hampered in a waterlogged region, yet it can withstand and eventually flourish herein and it can as well endure flooding (Uu.nl.com, 2012).

For the purpose of this study, six RGEs have been enumerated. They include: Upland, Hydromorphic, Rain-fed Lowland, Irrigated Lowland, Deep Inland Water and Mangrove Swamp (Longtau, 2009).

Table 2.2: A Summary of agro-ecological zone of rice production

TYPE	CHARACTERISTICS	GEOGRAPHIC SPREAD
UPLAND	Rain-fed rice grown on free draining fertile soils. This is called dry uplands	Prevalent, except the coasts, high rain forests and Sahel
HYDROMORPHIC	Rain-fed rice grown on soils with shallow ground water table or an impermeable	Very common at the margins of streams and transitional zone between

	layer. This is also called wet uplands	upland and swamps of rivers in the savanna
LOWLAND	Rain-fed or irrigated rice in aquatic conditions or medium ground water table. Water covers the soil completely at some stage during the cropping season. These are called shallow swamps or *Fadama*.	Very widespread from high rain forest to Sahel
DEEP INLAND WATER	Rain-fed rice grown on soils with deep water table. The rice crop floats at some level and harvesting may be done from a canoe. These are also called deep *Fadama* or floodplain	Chad basin, floodplains of the Niger, Benue, Kaduna, Gbako, Hadejia, Kamodugu-Yobe, and Sokoto-Rima basin
MANGROVE SWAMPS	Rice grown at the coast of swamps of the high rain forest	Predominant in coastal water regions and Warri area in Delta state

Source: Longtau, (2009).

2.4.3 Rice production in Niger State

Given the latest interest to grow the rice sector of the economy, the state of Niger has emerged as a major contributor as notable strides recorded with regards to rice cultivation in the state verified that the "rice revolution initiative" of the FGN is indeed on track while further measures taken to improve the initiative also stimulated the cultivation of the crop in both dry and wet season (NSBS, 2012).

The independence clamored by stakeholders in food production is the responsibility of any government at the national and state level. Within this purview, the state has become a leading contributor to agricultural productivity, particularly rice production both at the regional and state levels (FMARD, 2013).

So much so that agronomic activities continue to assume top most priority in the state and records have shown that since 2001 onwards, per hectare yield in a variety of major crops (including rice) within the state have not only increased, but exceeded expectations (Niger State Bureau of Statistics (NSBS), 2012). Therefore, rice production profile of the country indicated that the state stands as a major contributor to rice cultivation in the country.

Table 2.3: The state of Niger showcasing the dominant system and remarks on rice production.

STATE	DOMINANT SYSTEM	REMARKS
NIGER	Irrigated Lowlands, Rain-fed Lowlands, Rain-fed Upland and Hydromorphic	Home of rice culture in Nigeria and leading rice research institute (NCRI). Rice production systems are vulnerable to external factors, such as; flooding due to excess discharge of water from dams like Kainji, Shiroro and Gbako river. Arguably, Niger state should rank first in the production of rice in Nigeria, in the past though, farmers had a bittersweet experience. For instance, in 2000, farmers at Badeggi were transplanting the first crop of rice only in November because floods had ruined the May/June cropping season, while in 2012, farmers at Tungan-kawo had a major setback due to flooding. WARDA's PVS trials are also located in the state. The National Fresh-water and Fisheries Research Institute (NIFFRI) should promote fish and rice culture in the state and the entire geo-political zone. In that way, rice and fish synergy can be maximized. The development of appropriate ox-drawn technology for the Kainji area can boost rice production as well.

Source: Longtau, (2009).

2.5 Comparison of irrigable and rain-fed rice cultivation in Nigeria

Osawe *et al.* (2017), stipulated that the average irrigated farm size recorded in the country was about 1.3 ha (3.21acre). This information supports the notion that the potential of this

system in Nigeria is greatly unexploited. Although, the irrigation production system had been pronounced to proffer more return compare to rain-fed system.

Reports further confirmed that irrigated rice production systems ensure ideal input level, high returns and better yield of which agronomists greatly desire. In addition, operating ratio tends to be low at just 15.80% while the total production cost of irrigation system is observed to be the lowest compared to other systems.

Whereas, for rain-fed production system where high cost of operations due to extensive cost of labour is predominant Osawe *et al.* (2017), remarked that the system was estimated to boast of 1.6 ha which is one of the highest rice revenue compared to others. Although, operating ratio under this system was also observed to be high at 29.48%.

Researchers have confirmed that there are strong indications that irrigated rice production system is associated with high gross margin compared to rain-fed production system (Osawe *et al.* 2017).

Tashikalma *et al.* (2014), analysis of some selected rain-fed and irrigated food crops in Adamawa state, Nigeria asserted that rice yield under irrigated production system recorded over 3,575.22kg compared to that produced under rain-fed system which pooled 2,513.10kg in the year 2009. This assertion implied that farmers participating in irrigation production system enjoy better yield couple with ideal input value and remarkable incomes compared to rain-fed production system across all AEZs found in the country.

The national area and production of paddy as revealed by the USAID country report in 2016, disclosed that irrigated production system cover an area of just about 17% and production covers 27%, while rain-fed production system categorized into two, namely rain-fed lowland and rain fed upland was reported to cover 47% in acreage, 57% in production, and 30% in acreage, 17% in total production respectively (National Research Council, (2009).

2.5.1 Irrigated rice production scheme in Nigeria

Irrigated rice production systems in the country include both large-scale irrigation scheme predominant in the North and small-scale inland valleys situated in the Southern part of the country. Some of the prominent rice irrigation schemes in Nigeria include:

1. South-Chad Irrigation Scheme with a capacity of 8,000 ha.
2. Sokoto-Rima River Basin Irrigation Scheme with a capacity of 4,000 ha.
3. Badeggi Irrigation Scheme with a capacity of 580 ha.
4. Edozhigi Irrigation Scheme with a capacity of 900 ha.
5. Shonga Irrigation Scheme with a capacity of 300 ha.
6. Loguma Irrigation Scheme with a capacity of 200 ha (Ayodele, 2016).
7. Tungan-kawo Irrigation Scheme with a capacity of 900 ha.

2.6 Related studies on rice (paddy) production using irrigation

Merem *et al.* (2017) in a research "Analyzing Rice Production Issues in Niger state of Nigeria" via a mix-scale technique of descriptive statistics and GIS to explore changing trends in rice production, remarked as follows: in spite of the drops recorded in the 1990s, rice productivity surpassed most of the neighboring states in every category from 2006 to 2010 as observed through other parameters including increased acreage under rice cultivation.

Within the period reviewed, GIS mapping identified dispersions and alterations as well as widespread diffusion of fertilizer application. The paper counseled variety of remedies together with the necessity for storage and bulk handling devices to open up rice markets, provision of geospatial and land information systems and constant monitoring of ecosystems adjacent to rice farms.

Balarane and Oladele (2014) thesis titled; Impact of Irrigation Farming in Livelihood Strategies amongst Small-holder Farmers in North-west Province of South-Africa. The authors adopted simple random sampling technique to select 66 male farmers from the population of the study. Data was collected through structured questionnaire and subjected to statistical analysis using frequencies, proportion and multivariate analysis. The study informed that majority of the farmers (65%) were above the age of 50 years with the least (9%) below 40 years. Government grants were enjoyed by a fair majority of 54.5% amongst the 53% involved in irrigation farming. The study also revealed that majority of the cultivated lands representing 92.4% belonged to the chiefs while 7.6% of cultivated land was privately owned. The study insisted that farmers affirmed to having adequate access to livelihood aspiration but access to financial capital was insufficient.

On the part of Ugalahi *et al.* (2016), reviewed the irrigation subsector in Nigeria, wherein the authors disclosed that the prospects of achieving self-reliance in rice production through irrigation and rain fed farming system is hampered by under developed subsector stimulated by fragmented, inconsistent and unimplemented policies plus the duplication of mandates by multiple water regulatory institutions. Measures proffered included, the realignment of practicable policies on irrigation and water resources couple with provision of subsidized farm implements and viable markets for rice farmers.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This comprises the methodical plan of what was done, why some methods were adopted and how data obtained were analyzed in achieving the research objectives. Moreover,

alternative sources of secondary data were used where applicable data was unavailable. These sources include; Research institutes, Government agencies, the internet and archives.

3.1 Source of data and type

3.1.1 Primary data: These were information obtained through field/reconnaissance survey which entails questionnaire administration and interviews

3.1.1.1 Field/Reconnaissance survey and interview: This on the spot assessment was aimed at examining the impact derived by the rice irrigation farmers through the irrigation scheme under study. Hence, farm lands were visited using purposive sampling technique while oral interviews were carried out simultaneously so as to verify answers provided by respondents.

3.1.1.2 Questionnaire development: it was constructed in English with guide to help respondents whenever need be. The questionnaire was guided by the primary objectives of the study as it was structured and administered to farmers with experience in agricultural activities and rice irrigation practices in particular. However, the copies of questionnaire were distributed to respondents where it elicited information such as household characteristics including demographic information (age group, marital status, educational qualification), production inputs (such as; labour, quantity/cost of fertilizer, herbicides, pesticides) output information (such as; yield/quantity produced), major challenges encountered and strategies adopted by the farmers for optimal production in the study area.

3.1.2 Secondary data: these were materials obtained at Departments or Agencies and Research institutes in the course of this study. These included: maps, yield of harvest and relevant documents and information that were utilized as alternatives appropriately.

3.2 Sampling size and selection procedure

3.2.1 Sampling size: Yamane's sampling size formula was adopted in delineating the sample size for the study area.

This is represented as follows:

$$\boldsymbol{n = \frac{N}{1+Ne^2}} \quad \text{----------(3.1)}$$

Where:

n= Sample size

N= Number of irrigation rice farmers

e=limit of tolerance (which is estimated at 0.05).

Hence:

N= 875

e= 0.05

Therefore,

$$\boldsymbol{n = \frac{875}{1 + 875(0.05)^2}}$$

$$\boldsymbol{n = \frac{875}{1 + 875(0.0025)}}$$

$$\boldsymbol{n = \frac{875}{1 + 2.18}}$$

$$\boldsymbol{n = \frac{875}{2.19}}$$

$$\boldsymbol{n = 400}$$

Therefore, our window into the population, that is the sample size for the study area stood at 400.

3.2.2 Sampling procedure

The study area is comprised of different clusters that are supported by the FGN IFAD/VCD programme served by the irrigation scheme supervised by UNRBDA. Kanko cluster was purposely chosen for this study due to its relevance. The cluster is primarily made up of Bankogi, Dankuwagi, Kanko, Kasakogi, Kodo/Yelwa and Maito communities with other sub-clusters within the ambit of the study area.

From the reconnaissance survey conducted, a register of 35 farmer groups, each comprising of 25 farmers, totaling 875 was made known to the researcher. Thereafter, a list of 400 rice irrigation farmers was derived as the sample size. Farmlands were visited and questionnaires were administered amongst the sample of the population.

3.2.3 Purposive sampling technique: the area where rice irrigation farming was exercised was purposely selected and the targeted population was the farmers.

3.3 Data Computation and Explanation

The Statistical Package for the Social Sciences (SPSS) and Microsoft excel was applied as appropriate to compute quantitative data involved in the study. The packages enabled the generation of multiple regression analysis, in which the Pearson's product-moment correlation coefficient was utilized to analyze the impact of rice irrigation farming and livelihood of communities participating at the scheme. While descriptive statistics of frequency count and percentages was utilized to analyze demography characteristics of respondents. The results were then presented in fables, figures and charts as applicable.

3.3.1: Response rate

Four Hundred (400) questionnaires were administered, where three hundred and sixty seven (367) were returned and analyzed for the study. 23 of the respondents were absent and could not submit theirs while 10 of the farmers' response were discarded and termed invalid because of the discrepancies observed.

Table 3.1: Response rate

STATEMENT	FREQUENCY	PERCENTAGE (%)
Questionnaire administered	400	100
Questionnaire Returned	367	91.75

Source: Author's work, 2019.

Table 3.1 reveals the response rate of the farmers in the study area. It depicts that out of 400 questionnaires administered, 367 representing 91.75% of the sampled population were returned and used because it captured the percentage needed to produce objective result for the study.

3.3.1.1 Objective 1: Identify the activities of irrigation in rice production in the study area.

Analysis to determine objective 1 was done using descriptive statistics so as to ascertain the percentage and frequency distribution of respondents' demography. Hence, figures and charts were applied.

3.3.1.2 Objective 2: Examine the impact of rice irrigation farming on livelihood of communities in the study area

Multiple regression analysis utilizing the Pearson Product-Moment Correlation Coefficient was applied to analyze the impact of irrigation farming experienced by the rice farmers participating at the Tungan-kawo irrigation scheme in Wushishi L.G.A The Pearson's 'r' was adopted to measure the strength of the relationship of the dependent and independent variables.

Pearson's r is represented as:

$$R\chi y = \frac{\frac{1}{\eta}\sum_{i=1}^{\eta}(\chi_i - \chi)(y_i - y)}{\sqrt{\frac{1}{\eta}\sum_{i=1}^{\eta}(\chi_i - \chi)_2 . \frac{1}{\eta}\sum_{i=1}^{\eta}(y_i - y)_2}} \text{----------(3.2)}$$

Where:

$R\chi y$ = Pearson's 'r'

η = Sample size.

χ and y = Means of the variables.

χ_i and y_i = Variables being correlated.

Confidence level stands at 95% for statistical significance.

3.3.1.3 Examine the degree of vulnerability of the rice irrigation scheme.

The level of vulnerability of farmers in relation to irrigation farming, which is objective 3, was estimated using vulnerability index. The vulnerability index was calculated using three indicators, namely; **exposure, sensitivity and adaptive capacity** as recounted by Jamshidi *et al.* (2018).

3.3.1.4 Examine strategies adopted to improve productivity in the study area

Descriptive statistics was used to analyze objective 4 where frequency count and simple percentage were adopted and explanation was carried out through the help of figures and charts.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Data presentation

4.1.1 Socio demographic features of respondents

Table 4.1: Age distribution of the farmers

Age Range	Frequency Count	Percentage (%)
18 – 38	245	66.8
39 – 59	119	32.4
60 and above	3	0.8
Total	367	100

Source: Author's work, 2019.

Table 4.1 depict the age distribution of the farmers. The table indicates that 66.8% of the respondents were within the range of 18 to 38 years, 32.4% belong to the age bracket of 39 to 59, while 0.8% was within the range of 60 years and above.

This indicated that significant number of the farmers have opportunity for more active years in agricultural activities, especially rice production which require commitment and dedication on the part of the farmers.

4.1.2 Gender spread of farmers

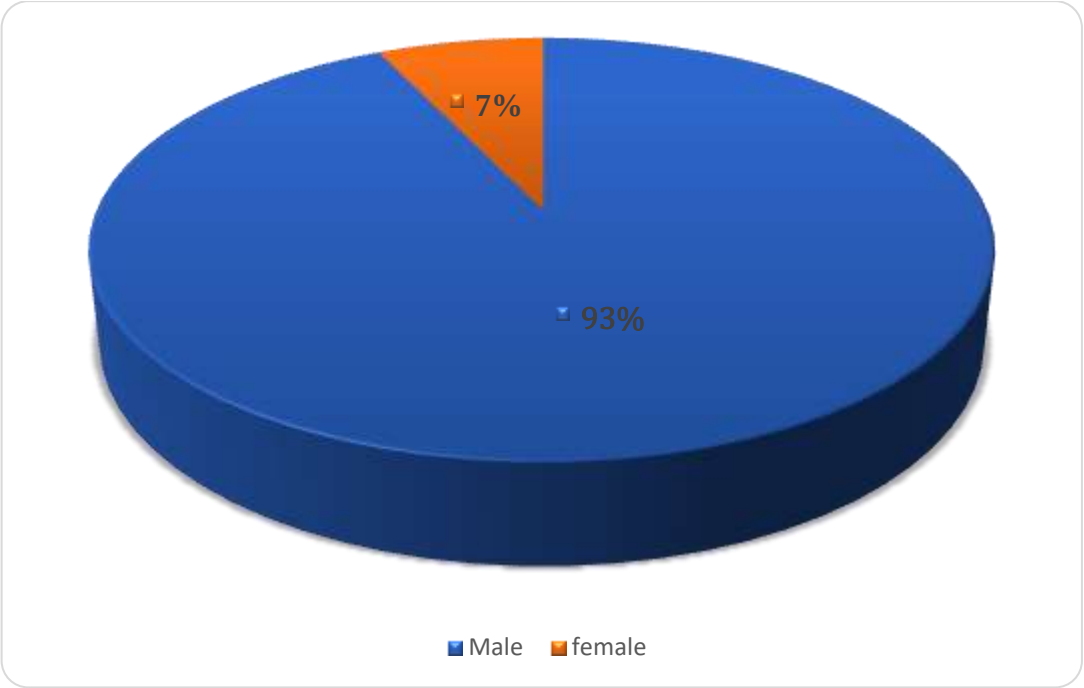

Figure 4.1: Gender distribution of farmers

Figure 4.1 portrays information on gender distribution of the farmers. It portrays that majority (93%) of the farmers within Tungan-kawo irrigation scheme were male while female farmers involved in rice irrigation framing represents 7%. As such, the ratio of female to male is absolutely low.

Although, the respondents attributed such phenomenon to the peculiarity and responsibility shouldered by males who are mostly the head and breadwinner of their respective families' coupled with the intense and demanding skills involved in rice cultivation.

4.1.3 Marital status of the farmers

Figure 4.2 shows the marital status of the farmers. The figure reveals that 92.1% of the farmers were married, while 7.1% of the farmers were single. This indication portends that most of the farmers were married.

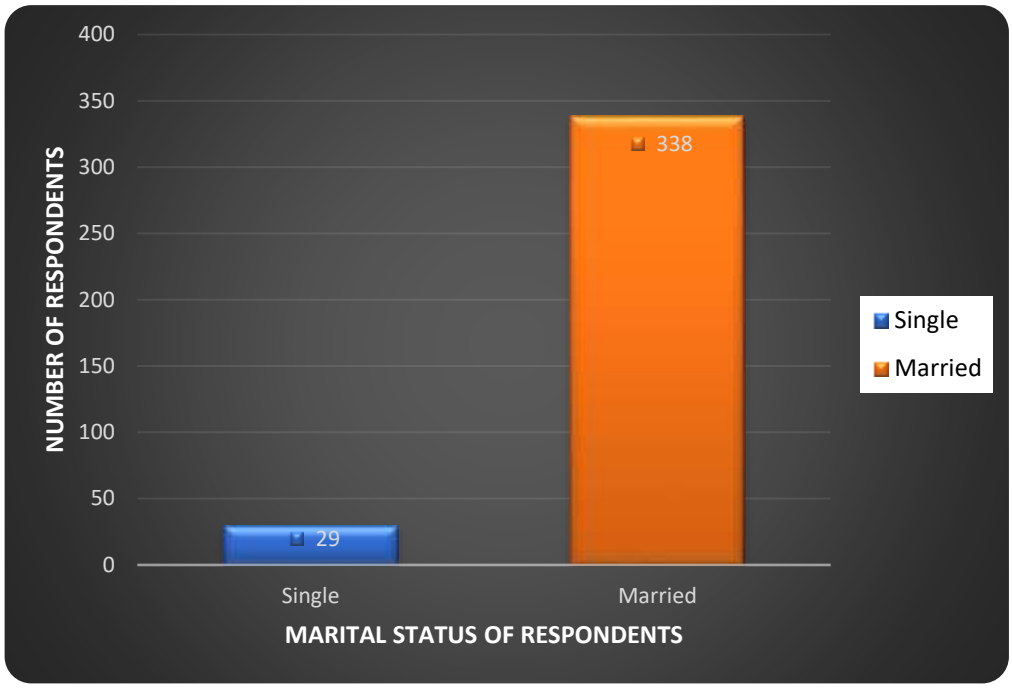

Figure 4.2: Marital Status of the Farmers.

The high marital status of the farmers within the study area was not only attributed to the increase in income level but also the cultural aspect of the people. As participatory farmers' of the scheme, financial capacity was observed to have improved, which inform the need for marrying more wives since polygamy is encouraged culturally.

Also, considering the fact that most of the farmers are male, living in a rural setting with low cost of living, farmers attested to having the capacity to afford their basic necessities and in extension support and cater for others.

4.1.4 Level of education of the farmers

Table 4.2 Level of education of the respondents

Level	Frequency Count	Percentage (%)
Primary	19	5.2
Secondary	118	32.2
Tertiary	194	52.9

Others	36	9.8
Total	367	100.0

Source: Author's work, 2019.

Table 4.2 reveals that about 5.2% had primary education, 32.2% of the farmers had secondary education while 52.9% had tertiary education. And 9.8% had other education such as adult education, religious education amongst others.

This implied that most of the farmers within the study area were partially educated because it was observed that the farmers are open to innovative ideas and new agronomic practices for enhanced productivity.

4.1.5 Household size of the farmers

Table 4.3 reveals the household size of the farmers. The result discloses that 25.6% of the respondents had a family size of less than 6, 70.0% had 6 to 10 dependents, while 4.4% had 11 to 15 dependents. On the average, most of the farmers' household size was within the range of 6 to 10 at the time of survey.

Table 4.3: Household size of the farmers

Household size	Frequency Count	Percentage (%)
<6	94	25.6
6-10	257	70.0
11-15	16	4.4
Total	367	100.0

Source: Author's work, 2019.

The household size of the farmers recorded indicates that there is indeed some influence derived from rice irrigation agriculture because most of them who were married play a significant part in providing for members of their various households. It was also observed that the heads of respective households utilize every family member available to assist in their farm fields and other processes involved in rice cultivation, such as threshing, bagging of produce and transportation of produce.

4.2 Rice irrigation practices within Tungan kawo irrigation scheme

Table 4.4: The activities involve in rice irrigation farming

Variables	Frequency	Percentage
Farming as major occupation		
Yes	321	87.5
No	46	12.5
Farming experience		
5 – 10	112	30.5
11 – 20	243	66.2
21yrs and above	12	3.3
How many farmers are into rice irrigation farming?		
Yes	367	100
No	0	0.0
Experience of rice irrigational farming		
1 – 5yrs	65	17.7
6 – 10yrs	74	20.2
10yrs and above	228	62.1
Adopted method in rice irrigational farming		
Pumps	269	73.3
Calabash/shadouf	93	25.3
Gravity/natural flow	5	1.4
Type of rice cultivated		
Faro 44	312	85.0
Ofada rice	5	1.4
Lowland rice	38	10.4
Faro 52	12	3.3
Sources of seedlings		
ADP	17	4.6
Commercial	335	91.3
Donor agencies	15	4.1
Application of fertilizers		
Yes	367	100
No	0	0.0
Size of irrigation farm lands		

1-5 acres	168	45.8
6-10 acres	85	23.2
11-15 acres	59	16.1
16 acres and above	55	15.0
Visitations of extension workers		
Yes	341	92.9
No	26	7.1
Number of visitation	38	10.4
Once	32	8.7
Twice	49	13.4
Thrice	248	67.6
Four times and above		
Cooperative society/Association	356	97.0
Yes	1	3.0
No		
Access to credit lines/loans	13	3.5
Yes	354	96.5
No		

Source: Field survey, 2019.

The result in table 4.4 discloses that 87.5% of the farmers practice farming as a major occupation, while 12.5% exercised it as a secondary occupation (personal interest). Hence, majority of the respondents were exclusively into rice irrigation farming for income purposes and upkeep.

Approximately 66.2% had farming experience of 11–20 years, 30.5% had experience of 5 to10years, while 3.3% comprised of the respondents with experience of 21years and above. As such, farmers with experience of 10years and above were predominant in rice irrigation activities within the study area. This portends the rate at which the respondents' knowledge on rice farming and agriculture practices in general influence their harvest.

The analysis also reveals that a significant number of farmers comprising of 73.3% used pumps method of irrigation, while 25.3% utilized calabash/shadouf, and 1.4% used gravity or natural flow. This indicated that pumps are mostly adopted in order to wet their rice fields appropriately.

Most of the farmers representing 85.0% cultivated *Faro* 44, 1.4% cultivated *Ofada* rice, while 3.3% harvested Lowland rice, and 10.4% of the total respondents cultivated *Faro* 52. As such, the predominant number of farmers at Tungan-kawo irrigation scheme cultivated *Faro 44* because of it is popularity with marketers and consumers alike.

The major source of seedlings obtained were through commercial medium. It is noteworthy to state that farmers utilized the technique of transplanting of which respondents affirmed of its productivity as it supports good yield. It was also observed that all the farmers attested to the application of fertilizer for optimal production.

Furthermore, 45.8% of the farmers had farm land of 1–5 acres, while 23.2% had 6–10 acres, 16.1% had 11-15 acres, and the least comprised of 15.0% whom had 16 acres and above.

More so, over 90% of the farmers recorded to had been visited by extension agents, and most of these farmers indicated to had such visits a number of four times and above.

Farmers comprising of 97.0% of the total sampled population indicated to having membership to a cooperative society while those with no membership to any association comprised of 3.0% at the time of survey. The result also indicated that majority of the farmers (96.5%) had no access to any form of loan/credit line.

4.2.1 Land tenure cultivated by farmers

Figure 4.3 reveals the land cultivated by rice irrigation farmers within the study area. The graph displays that most of the farmers, comprising of 58.9% cultivated on inherited lands, rented lands were cultivated by 28.3%, borrowed lands by 6.5% of the respondents, purchased lands 5.7%, and gifted lands 0.5%. Therefore, majority of these farmers obtain the land they cultivated on either by inheritance or rentage. It is worthy to note that the rent of farm lands varies between ₦7,000 to ₦ 8,000 an acre per annum.

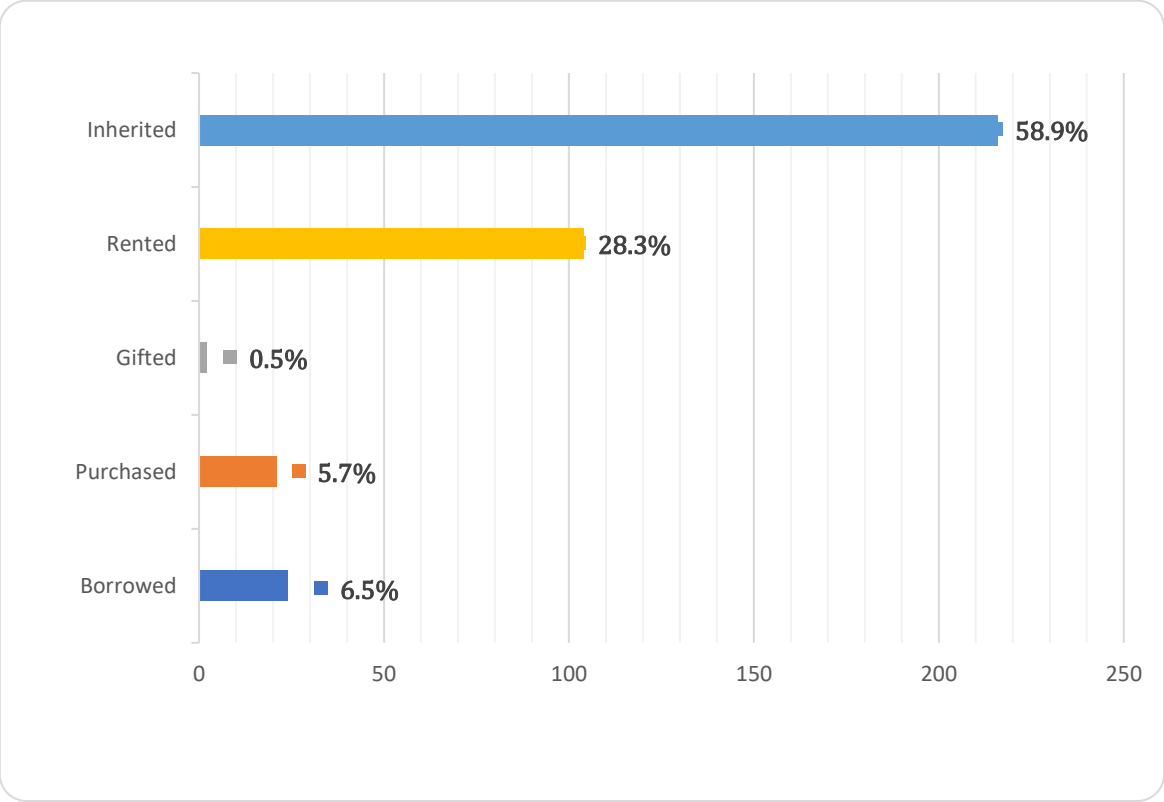

Figure 4.3 land tenure cultivated by farmers

This implies that majority of the acreage were either inherited or rented out to interested farmers for rice production. It was observed that majority of the farmers operated at small

scale depending on their capacity, while those with larger farm fields were the prominent farmers found in the society. For example, the "*Sarkin Noma*" (king of farmers) whom was accredited 20 acres and above.

4.3 Impact of rice irrigation farming on livelihood of the communities

4.3.1 Number of harvest per annum (in metric tonnes)

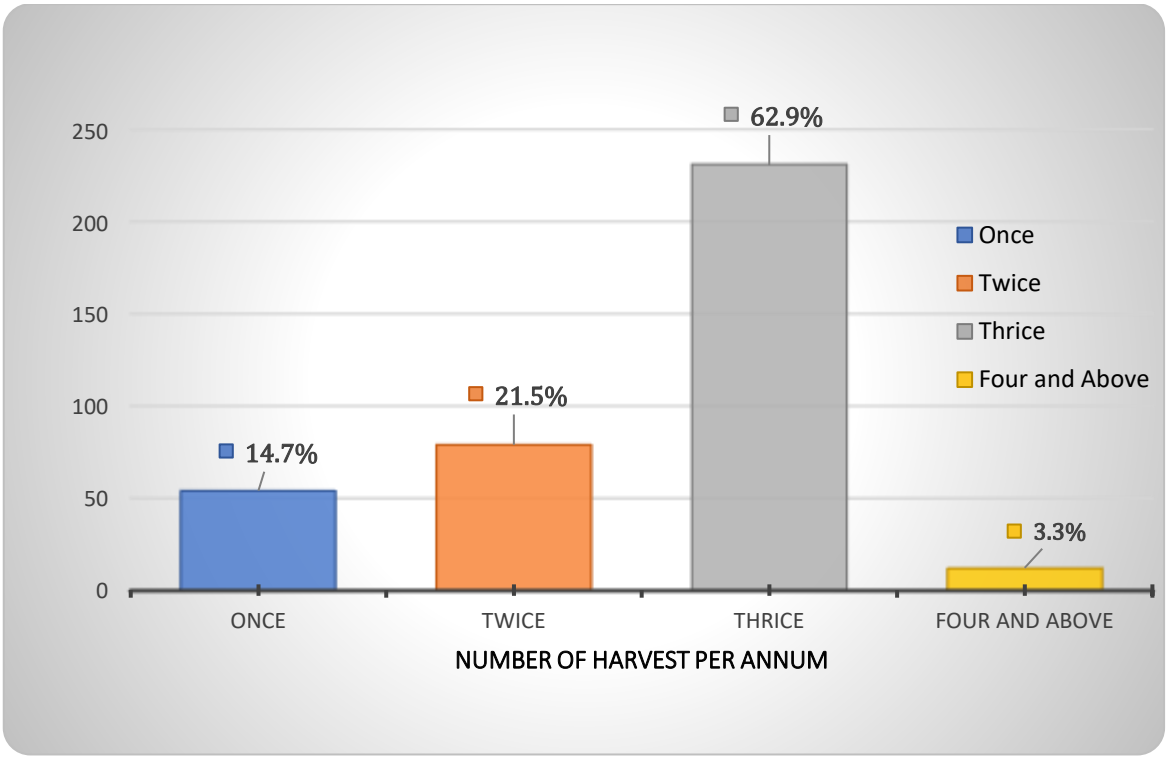

Figure 4.4 Number of harvest per annum.

Figure 4.4 depict the number of farmer's harvest per annum. Farmers attested to the significance and importance of irrigation on their annual harvest. A number of farmers representing 14.7% harvested once in a year, 21.5% harvested twice in a year, 62.9% cultivated thrice at the same rate and 3.3% of the respondents harvested four times and above annually.

The implication of this is that majority of the farmers cultivated their farm lands more than once in a year. This signifies a positive outlook with regards to their income level and contribution towards the national production of rice.

4.3.2 Production of rice per acre (MT)

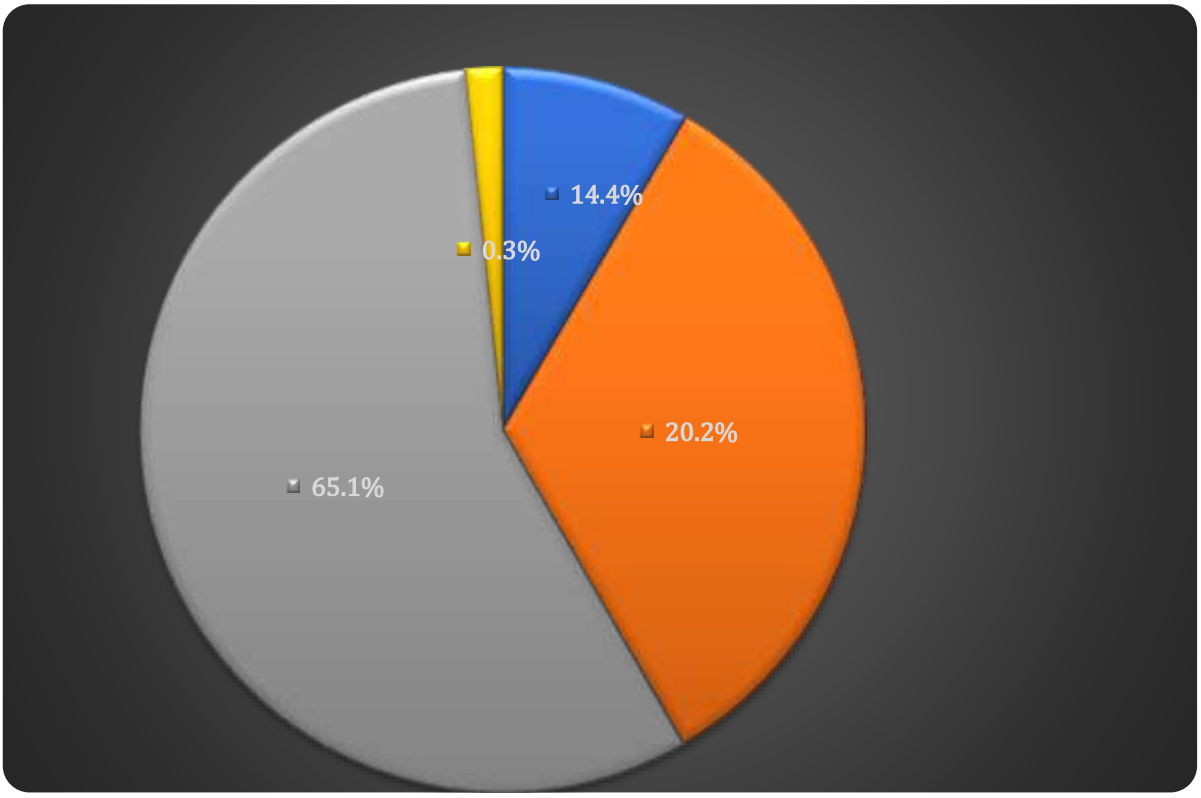

Figure 4.5: Rice production per acre (MT)

The Figure 4.5 shows rice production per acre (MT). The result discloses that 14.4% of the farmers harvested rice 1-3MT/acre, 65.1% cultivated rice 4–7MT/acre, 20.2% of the respondents harvested 8–10MT/acre and finally, 0.3%of the farmers, constituting the least percentage cultivated 11MT and above per acre.

This rate of harvest per acre signified in figure 4.5 is an indication of how encouraging the irrigation scheme have been towards the living strategies of the respondents, thereby influencing market price because a remarkable number of the farmers harvested beyond 6 MT per acre.

4.3.3 Annual estimated income

Table 4.5: Annual estimated income

Estimated Income(₦)	Frequency	Percentage
250,000 - 500,000	31	8.4
501,000 - 1,000,000	122	33.2
1,001,000 - 2,000,000	208	56.7

2,001,000 and above	6	1.6
Total	367	100.0

Source: Field survey, 2019.

Table 4.5 relates the annual estimated income based on the respondents harvest rate per annum. The result reveals that farmers representing (8.4%) of the total sample had annual income range of ₦ 250,000 - ₦500,000, while (33.2%) estimated income fell within the range of ₦501,000 to ₦1,000,000, about (56.7%) were within the range ₦ 1,001,000 - ₦ 2,000,000 and finally, (1.6%) were within the range ₦2,001,000 and above.

Needful to note that majority of the farmers had estimated income within the range of ₦ 1,000,000 to ₦ 2,000,000 This suggest that rice irrigation farming can be economically gainful because majority of the farmers revealed to owning lands and properties, while some ventured in other business investments such as transportation.

4.3.4 Pearson's product-moment correlation coefficient

Table 4.6 depicts the correlation between rice irrigation farming and livelihood of the community in the study area. The result shows that 0.571 coefficient of correlation indicates that there is a moderate positive correlation between rice irrigation farming and livelihood of the community. Also, the significance value of 0.000 indicates statistical significance of the relationship. Hence, there is a positive impact of rice irrigation farming on livelihood of the community in the study area.

Table 4.6 Pearson's product-moment correlation coefficient test on impact of rice irrigation farming and livelihood of the community in the Study Area

Variables		**Rice Irrigation Farming**	**Livelihood of Community**
Rice irrigation farming	Pearson's Correlation	1	.571**
	Sig. (2-tailed)		.000
	N	367	367
Livelihood of the Community	Pearson Correlation	.571**	1
	Sig. (2-tailed)	.000	
	N	367	367

Source: Field survey, 2019.

4.3.5 Comparison of Rain-fed and Irrigation System of Rice Production

Figure 4.6 highlights the production of rice in the two production system considered in this study, where it indicates the estimate of paddy production measured in metric tonnes within the period of (1993-2018.) The figure also affirms the challenges recorded at the irrigation scheme in terms of rice yield as a result of flooding especially within 2000 to

2007 where yield from both production system was low and there was significant fluctuation recorded.

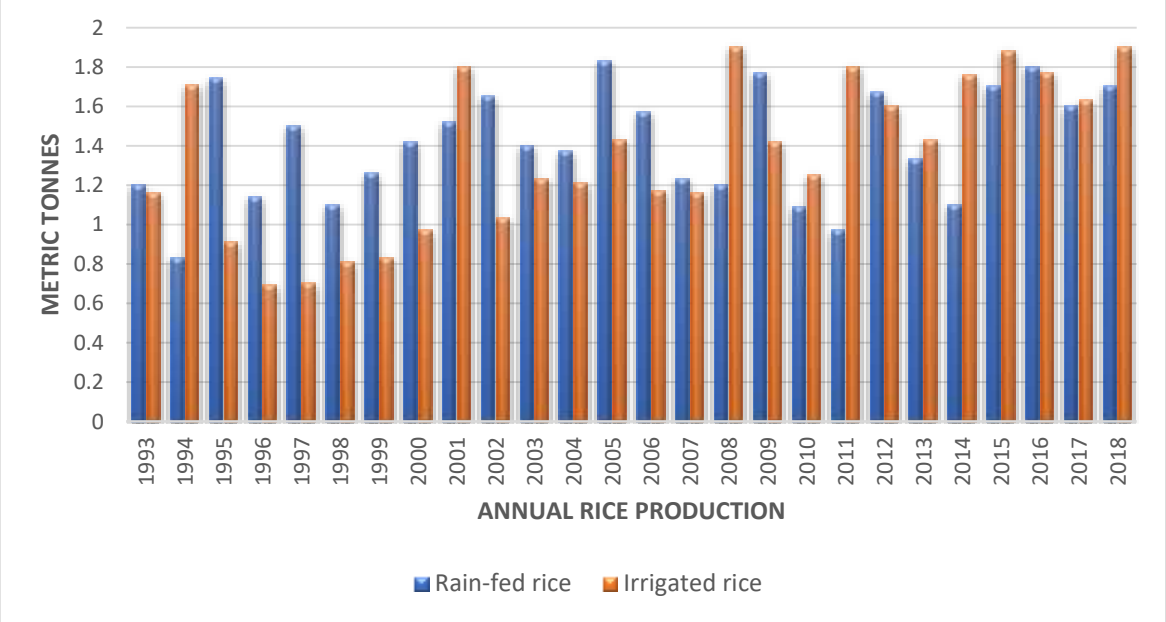

Figure 4.6: Comparison of rain-fed and irrigation system of rice production.

In addition, figure 4.6 showcased that there was a surge in production level from 2008 onwards. Although, it was marred with fluctuation in productivity due to external forces (for example, flooding), yet there was significant result attain in rice output due majorly to concerted effort plus friendly policy directed at the scheme by the government.

4.4 The degree of vulnerability of the rice irrigation scheme

Table 4.7 displays the irrigation scheme vulnerability index of the farmers. The vulnerability level was classified into three groups according to the household vulnerability index.

Table 4.7 Vulnerability level of farmlands to climate variability.

Level of vulnerability	Frequency	Percentage
Low > 0 < 0.33	121	33.0
Moderate ≤ 0.33 < 0.66	242	65.9
High ≥ 0.66 ≤ 1.0	4	1.1

Source: field survey (2019)

Table 4.7 relates that the first group with vulnerability value of less than 0.33 was labeled as low vulnerability, which implied that the farmers were in a vulnerable situation but still able to cope with number of external assistance. The second group with vulnerability value between 0.33–0.66 was classified as moderate group. These are the farmers that need urgent but temporary external assistance to recover from shocks. Lastly, the high level of vulnerability group with values above 0.66 were the class of farmers that were in critical situation but could be supported through educational, financial, institutional and even political aid to improve their adaptive capacity.

4.4.1 Challenges encountered during irrigation farming

Table 4.8: Challenges encountered at the irrigation scheme

Challenges	Frequency count	Percentage (%)
Lack of financial support	356	97.0
Inadequate irrigable farm lands	359	97.8
Low patronage of farm produce	349	95.1
Absence of processing mills	367	100.0
Insufficient power supply	316	86.1

*****multiple responses were allowed
Source: Author's work, 2019**.**

Table 4.8 reveals the challenges encountered by the famers. Critical among these challenges are: absence of processing mills which ranked first with 100% of the farmers lamenting, inadequate irrigable farm land was the challenge ranked second with 97.8% of respondents, lack of financial support ranked third was a challenge encountered by 97.0% of the respondents, low patronage of farm produce was another challenge the farmers suffer with 95.1% of them complaining, and insufficient power supply with 86.1% of respondents. Farmers within the irrigation scheme were given the liberty to make their choice as appropriate they deem fit considering what challenges listed they encounter in cultivating their rice fields.

4.5 Strategies adopted to improve productivity

Table 4.9: Strategies adopted to improve farm productivity.

Statement	Yes (%)	No (%)
Use of specific seeds for improved yield	362(98.6)	5(1.4)
Fertilizer application	367(100.0)	0(0.0)
Application of pesticides/herbicides	359(97.8)	8(2.2)

***** Multiple responses were allowed
Source: Author's work, 2019.

Table 4.9 display that 98.6% of the farmers affirmed to the use of improved seedlings/varieties in order to enhance their crop yield while only 1.4% responded to not using improved variety. All the farmers responded in the positive to the application of fertilizer on their rice fields while 97.8 % of the farmers utilize pesticides and herbicides on their crops. Worthy of note is that multiple responses were made by the farmers.

The process of farm management which entails, improved varieties, fertilizer application and use of pesticides and herbicides was highly adopted as recoded from respondents in the study area. This implied that farmers appreciated that proper farm management techniques compliment their effort for enhanced productivity.

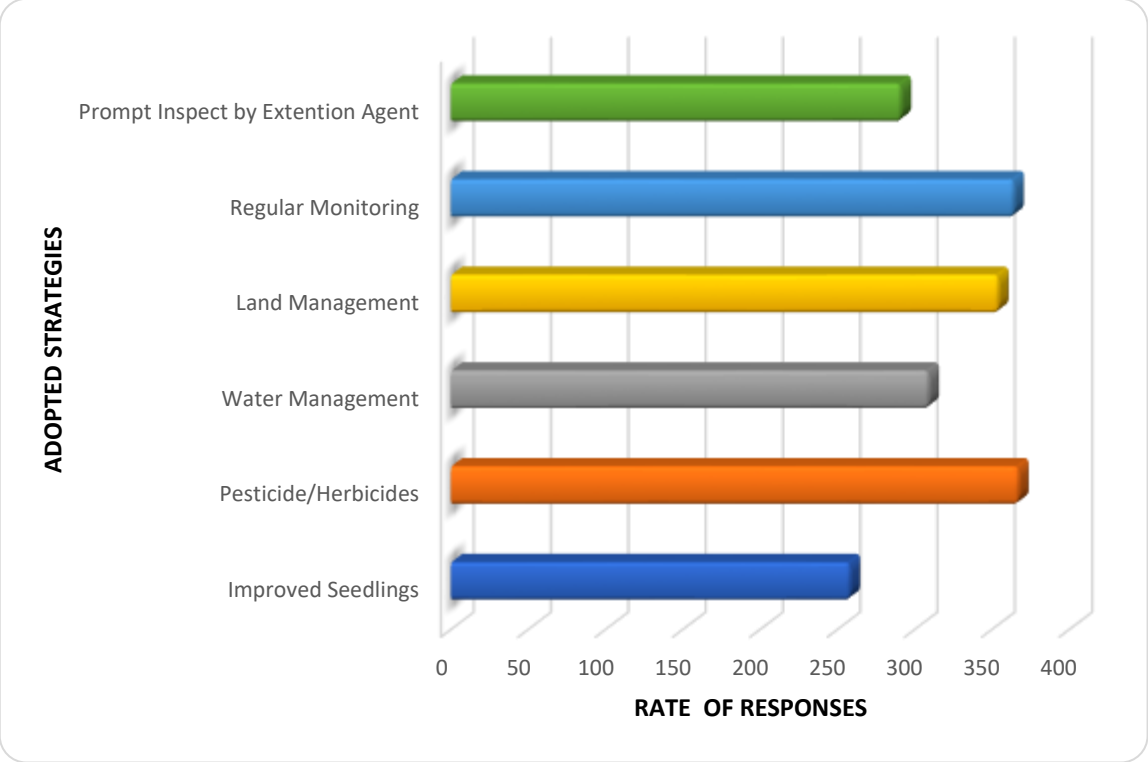

Figure 4.7: Strategies adopted by farmers to enhance rice yield.

The figure 4.7 indicated that adopted strategies amongst the farmers such as; prompt inspection and enlightenment from agricultural extension workers can result to enhanced rice production because information on new agronomic technologies are periodically

disseminated to farmers on the field. The act of land and water management is vital for ideal irrigation practices, as such; farmers are educated on improved measures on resource management. Application of both pesticides and herbicides contribute immensely to rice production while the use of improved varieties by irrigation rice farmers is also ideal in enhancing greater productivity.

4.6 Summary of the findings

Socio demographic data of the farmers was analyzed and also the following findings were discovered:

The study reveals that 321 farmers representing 87.5% observe farming as a major occupation, while 12.5% exercised it as a secondary occupation. This indicates that majority of the respondents needed to attain objective result were into farming activities.

The result additionally disclosed that during the survey, majority of the farmers consisting of 243 respondents, approximating 66.2% had experience in farming of 11–20years, 112 of respondents totaling 30.5% had 5–10years expertise, and 12 of them representing 30.3% were those with experience of 21years and above. This portray that majority of the farmers practicing rice irrigation have tremendous expertise in rice irrigation farming of 10years and above.

The analysis additionally disclosed that 269 of respondents constituting 73.3% used pumps technique for watering their rice fields, 93 of them constituting 25.3% utilized calabash/shadouf, while few of the farmers making up 1.4% used gravity or natural flow to water their fields. Result also disclosed that majority of these farmers (85.0%) cultivated *Faro* 44. It had been additionally ascertained that all of the farmers applied fertilizers to reinforce crop turn out, though, seedlings were purchased by farmers. In addition, over 45% of the farmers cultivate 1 to 5 acres.

Furthermore, 90% of the farmers were visited by extension agents, and most were visited fourfold and above. 356 of the farmers, which is 97.0% were associated with a cooperative society, while 11 of them constituting 3.0% were not in any cooperative society at the time of survey. The result additionally unveiled that none of the farmers had access to loans/credit lines.

With regards to the possession kinds of land cultivated by the respondents at the irrigation scheme. The analysis disclosed that 24 farmers representing 6.5% borrowed the land, 21 of respondents constituting 5.7% purchased their field, 2 of the farmers approximating 0.5% were gifted the land, 104 of respondents totaling 28.3% rented the land, while 216 of them, approximating 58.9% inherited the land. However, a distinguished range of the farmers whom obtained land through rentage, had it at the range of ₦7, 000 – ₦8,000 per acre annually.

Furthermore, 62% of the respondents harvested thrice annually. The result also revealed that the majority of the farmers (65.1%) harvested 4–7MT per acre. This implied that the irrigation scheme has absolutely influence the harvest rate of farmers and in turn affecting market price. This development was ascertained by a majority of the farmers who

recorded to possess a calculable financial gain within the range of ₦1,000,000 to ₦2,000,000 annually.

The study also identified the correlation between rice irrigation farming and living strategy of the communities. The findings identified a 0.571 coefficient correlation which indicates that there was moderate correlation between rice irrigation farming practiced by respondents and output of their fields. Hence, the significance value of 0.000 was derived.

Meanwhile, in comparing the irrigation production system of rice to rain-fed system, the study disclosed that production level was low compared to rain-fed system within the period of 1995 to 2002. Whereas, there was significance improvement in rice yield from 2002 onwards, though it was marred by fluctuations as a result of natural phenomena (for example, flooding). The enhanced output level is often attributed to the relevance directed at the sector by government and supporting partners (for example, IFAD).

The results of the study additionally disclosed the vulnerability index of the irrigation scheme to climate variability. The result indicated that about 33.6% of the respondents were lowly vulnerable, 65.9% were moderately vulnerable and 1.1% were extremely vulnerable. The vulnerability level can be alleviated by providing assistance to these farmers so as to cushion the effects of climatic variability. Amongst the numerous challenges encountered by the farmers include: lack of monetary support, inadequate irrigable land area, low patronage of farm produce, absence of processing mills and insufficient power supply.

Further findings emanated from the study declared that 362 farmers, comprising of 98.6% used improved seedlings/varieties so as to boost crop yield. All the farmers unanimously affirmed to the use of chemicals (pesticides and herbicides) on the farm lands for best productivity. Different methods adopted include; application of pesticide/herbicides, water management, land management, regular and prompt scrutiny by agricultural extension agents.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Efforts directed at improving rice production in Wushishi L.G.A, Niger state, Nigeria have started producing dividends as can be witness in the influx of locally produced rice in our homes and markets. It was deduced that rice yield tripled as a result of multiple planting practiced annually coupled with provision of quality seeds and other implements that enabled farmers plant their crops in the best possible way. Such development if practically sustained across the country will remarkably reduce rice importation, improve the livelihood of citizens and help attain self-reliance in rice production for prosperity.

It is pertinent to emphasize the need for stability in Government policies in order to keep the momentum on the achievement recorded thus far. The reason why some policies fail is lack of continuity. As such, the Rice Transformation Agenda of which the Agricultural Production Policy was built upon was critically scrutinized and incorporated to the rice revolution program which has not only improved paddy (rice) production but has created jobs through the value chain.

Also, harmony could be created in the study area and benefits derived if opportunities are created for people of the area to participate in the process of production. With good agronomical practices, production, processing and marketing will be optimally maximized. Thus, improving the livelihood of farmers and all involved in the value chain.

Nevertheless, investment in infrastructure is greatly needed to encourage more private investors and small-holder farmers in irrigation practices. One way to increase productivity is to ensure a good water supply to crops. Irrigation is a tried and tested measure. Although, only a small percentage of farms in Nigeria have access to it. Nowadays, governments at all levels and donor agencies are developing initiatives for optimal irrigation practices.

5.2 Recommendations

It is the opinion of the author that:

1. Relevant agencies should come to the aid of farmers by resuscitating the fallow lands through sustainable management of canals through which farmers water their rice fields.
2. Necessary infrastructure such as industrialized processing mills, sustainable adequate energy, bulk storage facilities and accessible market should be made available for optimal production across the value chain.
3. Sensitization and enlightenment of the farmers is of utmost importance. Such initiative can help the educated-qualified farmers' step-down knowledge to the less educated ones within and elsewhere.
4. The Tungan-kawo dam has a holding capacity of 3.5 million metric cube but only 1.5 million metric cube is attainable, due to unwanted particles such as; sand, weeds and

rubbish that have filled the water. Hence, relevant authorities should be deployed to help rid it from these unwanted debris.

5. It is important to see agriculture as business. As such, people from all walks of life should be encouraged to embrace it. As such, the FGN should incentivize farming activities through subsidization of farm implements because remarkable agriculture can ensure poverty reduction, reduce unemployment and produce green-agriculture entrepreneurs.
6. It is also recommended that a bottom-top approach should be encouraged and implemented to the latter, as this can curb the distrust farmers portray against Government officials.

Therefore, the time has come to expand the scope of this laudable initiative to cover other crops, such as cowpea which is also of great value to the economy.

5.3 Contribution to Knowledge

- The study disclosed that Tungan-Kawo irrigation scheme is of positive impact to livelihood strategies of farmers practicing rice cultivation within the study area.
- It informed the need for the sustenance of the scheme through the implementation of policies directed at improving rice irrigation practices.
- It acknowledged the resolve of the youth in embracing rice farming and agronomic practices generally.
- It highlighted the concerted efforts directed at improving irrigation of rice production system which include; production, processing and marketing.
- It also provides an insight towards the production of rice in both irrigation system and rainfed system within the study area.
- It acknowledged the contribution of the UNRBDA in the development of the scheme and rice farmers participating in the scheme.

REFERENCES

AGENDA 2063: "Agenda 2063 Vision and Priorities" Retrieved from http://agenda2063.au.int/en/vision.

Ajah J., & Ajah F.C., (2014): Socio-economic Determinants of Small-scale Rice Farmers Output in Abuja, Nigeria. *Asian Journal of Rural Development. 4: 16-24.*

Akinbile, C.O., 2010. Behavioural Pattern of Upland Rice Agronomic Parameters to Variable Water Supply in Nigeria. *Journal Plant Breed and Crop Science 2: 73-80.*

Ayodele O.J., (2016). Economic Analysis of Irrigated Rice Production in Kura L.G.A of Kano state, Nigeria. Ahmadu Bello University Zaria, Nigeria. Retrieved from http://www.researchgate.net

B.B.C World News (2019): *Inside Business Africa*. Audio recorded on March 24, 2019.

Balarane A., & Oladele O.I., (2014). The Impact of Irrigation Farming on Livelihood Strategies Among Smallholders Farmers in the North West Province, South Africa.

DontsopNguezet, P.M., Diagne A., Okoruwa, V.O., & Ojehomon V. (2011). Impact of Improved Rice Technology on Income and Poverty among Rice Farming Households in Nigeria. *25th conference of the Centre for the Studies of African Economics (CSAE).* Retrieved from http://www.universityofoxford.uk

Food Agricultural Organization, Corporate Statistical Database FAOSTAT, (2017). Retrieved from http://www.wikipedia.com.

Food Agricultural Organization (2015). The state of the World's Land and Water Resources for Food and Agriculture. *Managing systems at risk regional overview of food insecurity Africa*. Retrieved from http://www.fao.com

Federal Ministry of Agriculture and Rural Development and National Bureau of Statistics. (2012). *Collaborative Survey on National Agriculture Sample Survey (NASS) 2010/2011*. Abuja FCT: Federal Ministry of Agriculture and Rural Development. Retrieved from http://www.fmard.ng

Folorunso L.A., (2008). Assessment of Sustainability of Food Crop Production in the *Fadama* of Southern Guinea Savannah of Niger state, Nigeria. Department of Agricultural Economics and Farm Management, University of Ilorin, Nigeria.

Intergovernmental Panel on Climate Change, (2013): Climate Change (2013): The Physical Science Basis. *United Nations Environment Program. 6. 507*. Retrieved from http://www.ipcc.ch.

International Rice Research Institute (IRRI) Rice Knowledge Bank. Retrieved from http://www.knowledgebank.irri.org.

Jamshidi, O.A., Khalil, A., Hossein, K., & Jurgen, A.S. (2018). Vulnerability to climate change of small holder farmers in the Hamadan province, Iran. Retrieved from http://www.researchgate.net

Lebdi, F., (2010). "Contraintes de l'Agriculture irriguee", Cahiers du Ciheam, 2010. Retrieved from http://www.acetforafrica.org

Longtau Selbut R., (2009): Multi Agency Partnerships in West Africa Agriculture: A Review and Description of Rice Production System in Nigeria. *Ecosystem Development Organization*, Plateau State, Nigeria.

Makusidi H.M., (2015): Impact of Tungan Kawo Dam Irrigation Project on Rice Production on Small Holder Farmers in Wushishi L.G. Niger State. *International Journal of Scientific and Research Publications, 5, 10, ISSN 2250- 3153*. Retrieved from http://www.ijsrp.org

Merem E.C., Twumasi Y., Wesley J., Isokpehi P., Shenge M., Fageir S., Crisler M., Romorno C., Hines A., Hirse G., Ochai S., Leggett S., & Nwagboso E. (2017). Analyzing Rice Production Issues in The Niger State Area of Nigeria's Middle Belt. *Food and Public Health 2017, 7(1): 7-22*, doi: 10.5923/j.fph.20170701.02

National Research Council, (2009): "African Rice". Lost Crops of Africa: Volume 1: Grains. Lost Crops of Africa. *National Academies Press*. ISBN 978-0-309-04990-0. Retrieved from http://www.wikimedia.org/wikipedia.

Niger State Bureau of Statistics (2012). Niger State Agricultural Statistics. Minna: Niger State, Nigeria. Retrieved from http://www.nigerstate.gov.ng

Niger State of Nigeria Fact book. (2013). Development Action Plan for Niger State. Minna, Niger State. Retrieved from http://www.nigerstate.gov.ng

Nigeria National Committee on Irrigation and Drainage (NINCID (2015). Retrieved from http://www.NINCID.org/cp_nigeria.html.

Nwalieji, U., & E.A. Onwubuya, (2013). Adaptation Practices to Climate change among Rice Farmers in Anambra State of Nigeria. *Journal of Agriculture Extension, 16: 42-49.*

Osawe A.W., Akinyosoye V.O., Omonana B.T., Okoruwa V.O., & Salman K.K., (2017). Productivity Differential in Rice Production Systems. Evidence from Farmers in Five Agro Ecological Zone in Nigeria. University of Ibadan, Nigeria. *Journal of Naturaceuticals and Food Science*. Retrieved from http://www.researchgate.net

Terwase I. T & Madu A.Y (2014): The impact of rice production, Consumption and importation in Nigeria. *The political economy perspective.* Retrieved from http://www.researchgate.net/publication/283078385.

University of Arkansas (2015). Rice Per Capita Consumption of Some Selected Countries. http://www.uark.edu/ua/ricerscg/pdfs/per_capita_rice_consumption_0_scle

Ugalahi U.B., Adeoye S.O., & Agbonlahor M.U., (2016). Irrigation Potentials and Rice Self Sufficiency in Nigeria: *National Research Economics*, doi:10.5897/AJAR2015.10284

United States Department of Agriculture, (2013): World Rice Trade. Retrieved from http://www. wikimedia.org/wikipedia

Upper Niger River Basin Development Authority (UNBRDA) (2011). Technical Brief on Tungan Kawo Irrigation Project. Retrieved from http://www. wikimedia.org.

Uu.nl.com "Plants capable of surviving flooding" (n.d). Retrieved on May 13, 2012 from http://www.uu.nl.com

World Bank Fact book (2016). Irrigated land. Central Intelligence Agency. Retrieved from http://www.worldbank.com.

Zeng J, Lu X., Tang X., & Tang Y. (2004). The System of Rice Intensification (SRI) for Super High Yield. *4th International Crop Science Congress, Brisbane, Australia*. Retrieved from http://www.ciifad.cornell.edu/sri/countries

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Dear Sir/Ma

IMPACT OF TUNGAN-KAWO IRRIGATION SCHEME ON RICE PRODUCTION IN WUSHISHI LOCAL GOVERNMENT, NIGER STATE, NIGERIA.

I am a student of the above-mentioned department conducting a research"Impact of Tungan-kawo Irrigation Scheme on Rice Production in Wushishi L.G.A, Niger State, Nigeria". The questionnaire is aimed at obtaining information that will assist in the research work. Any information provided will be utilize for research purposes.

Thank you in anticipation for your cooperation.

Yours Faithfully,

Ibrahim Jalaludeen Suleiman.

IMPACT OF TUNGAN KAWO IRRIGATION SCHEME ON RICE PRODUCTION

Thank you for agreeing to answer these few questions about the "impact of Tungan-kawo irrigation scheme on rice production in Wushishi, Niger state, Nigeria". Your answers

will be kept confidential and help develop a better understanding of the irrigation scheme on rice production.

Instruction: Please tick the option that best applies to you and fill the appropriate space.

Farmers Research Questionnaire

Cluster: Kanko

SECTION A: demographic characteristics

(i) Name.....

(ii) Community.....

(iii) Age of the respondent (a) 18-28 (b) 29-39 (c) 40-50 (d) 50 and above years

(iv) Gender (i) Male[ ] (ii) Female[ ]

(v) Marital status (i) Married[ ] (ii) Single[ ]

(vi) Educational qualification (i) Non-formal education[ ] (ii) Primary[ ] (iii) Junior Secondary[ ] (iv) Senior secondary[ ] (v)Tertiary[ ] (vi) Others, specify if any, ...

(vii) House-hold size (that is, number of people dependent on you) …….

SECTION B: Examine the activities of irrigation farming

(1) Is your major occupation farming? Yes [ ] or No [ ]

(2) If yes, how long have you been into farming? (a) 5-10yrs (b) 11-20yrs (c) 21yrs an above

(3) Are you into irrigational farming? Yes [ ] or No [ ]

(4) If yes, do you cultivate rice? Yes [ ] or No [ ]

(5) How long have you been into rice irrigational farming? (a) 1-5yrs (b) 6-10yrs (c) 10 yrs and above.

(7) What method of irrigation farming do you operate? (a) Pumps (b) calabash/shadouf

(c) Gravity or natural flow

(8) What type of rice do you use in your irrigation farming? (a) *Faro 44* (b) lowland rice

(c) *ofada rice* (d) faro 52

(9) Is it the same type of seedlings you used in rain-fed farming? Yes [ ] or No [ ]

(10) What is the source of your seedlings? (a) ADP (b) Commercial (c) donor agencies (d) others, specify ……..

(11) Do you use fertilizer in your farmland? Yes [ ] or No [ ]

(12) What is the size of your irrigation farm? (a) 1-5acres (b) 6 – 10acres (c) 11- 15acres (d) 16acres and above

(13) Do extension workers visit your farmlands (a) Yes [ ] (b) No [ ]

(14) If yes, how many times did extension workers visited your farm in the last season? (a) Once (b) twice (c) thrice (d) four times and above

(15) Do you belong to farmers' association or cooperative society (a) Yes [ ] (b) No [ ]

(16) If yes, how long have you been in the association or cooperative? ..... Years

(17) Do you have access to credit line (a) Yes [ ] (b) No [ ]

(18) If yes, indicate source and the amount received ……..

(19) Kindly indicate the ownership type of the land you cultivate

(a) Borrowed [ ] (b) Purchased [ ] (c) Gifted [ ] (d) Rented [ ] (e) Inherited [ ]

(20) What is the amount for an acre of land per season? ₦ .....

SECTION C: Examine the impact of rice irrigation farming on livelihood of the communities in the study area.

(1) Is rice irrigation farming a source of livelihood to you? Yes[ ] or No[ ]

(2) What is the estimate of your total yearly harvest? ……

(3) Has Tungan-Kawo irrigation scheme made farming easier for you? Yes[ ] or No[ ]

(4) Would you have been into irrigation farming without Tungan-Kawo irigation scheme? Yes[ ] or No[ ]

(5) Have irrigation farming improve your rice yield? Yes[ ] or No[ ]

(6) How many times do you harvest rice annually (a) once (b) twice (c) thrice (d) or more.

(7) How many tonnes do you harvest from your farmland per acre (a) 1-3 (b) 4 -7 (c) 8-10 (d) 11 and above.

SECTION D: Identify strategies adopted to improve productivity.

(1) Do you use specific seeds for improve yield? Yes [ ] or No [ ]

(2) Do you rely on fertilizer application for higher yield? Yes [ ] or No [ ]

(3) Do you experience any form of pest or disease problem? Yes [ ] or No [ ]

(4) What kind of pest or disease trouble your farm? (a) birds (b) insects

(5) State the adopted strategies exercised to enhance rice yield?

(i) ……..

(ii) ……

(iii) ……

(iv) ……

(v) …….

SECTION E: Examine the degree of vulnerability of the rice irrigation scheme.

(1) Have you experience flooding on your farmland? Yes [ ] or No [ ]

(2) Has the Tungan-kawo dam worsen flooding event on your farmland? Yes [ ] or No [ ]

(3) Do you receive any form of warning from the authorities in times of danger? Yes [ ] or No [ ]

(4) What are the challenges encountered during rice irrigation farming?

(i) …….

(ii) …….

(iii) ……..

(iv) ……..

(v) ……..

Thank you for your time. You have helped to make the public enlightened about the Tungan-kawo irrigation scheme on rice production in Wushishi, Niger state, Nigeria.