`IMPACT OF HADEJIA VALLEY IRRIGATION (HVIP) PROJECT ON CROP PRODUCTIVITY AND POVERTY REDUCTION IN JIGAWA STATE, NIGERIA

BY

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

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MARCH, 2016

DECLARATION

I hereby declare that the work in this thesis entitled **‘’ Impact of Hadejia Valley Irrigation Project (HVIP) on Crop Productivity and Poverty Reduction in Jigawa State”** has been written by me and it is my research work. No part of this work has been presented in any previous application for another Degree or Diploma in this or any other institution. All borrowed information has been duly acknowledged in the text and a list of references provided.

Mohammed Bashir UMAR **Date**
PhD/AGRIC/8714/2010-2011

CERTIFICATION

This thesis entitled "**Impact of Hadejia Valley Irrigation Project (HVIP) on Crop Productivity and Poverty Reduction in Jigawa State"** by Mohammed Bashir UMAR meets the regulations governing the award of the degree of PhD Agricultural Extension and Rural Sociology of the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

Professor T. K. Atala **Chairman, Supervisory Committee**	**Date**
Professor J. G. Akpoko **Member, Supervisory Committee**	**Date**
Professor S A. Sanni **Member, Supervisory Committee**	**Date**
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DEDICATION

To my parents, Alhaji Umaru and Hussaina.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Pages

APPENDIX

Pages

LIST OF ACRONYMS

Acronym	
AIRBDA	Anambra Imo River Basin Development Authority
ADPs	Agricultural Development Projects
ANOVA	Analysis of Variance
DFID	Department of International Development
DFRRI	Directorate of Food, Roads, and Rural Infrastructures
FAO	Food and Agriculture Organisation
FGN	Federal Government of Nigeria
FUA	Fadama Users' Associations
HJRBDA	Hadejia- Jama'are River Basin Development Authority
HVIA	Hadejia Valley Irrigation Authority
HVIP	Hadejia Valley Irrigation Project
IFAD	International Fund for Agricultural Development
KIs	Key Informants
KRIP	Kano River Irrigation Project
LAIP	Lower Anambra Irrigation Project
LEEDS	Local Government Economic Empowerment Development Strategy
LGAs	Local Government Areas
MANR	Ministry of Agriculture and Natural Resources
MSIRI	Mauritius Sugar Industry Research Institute
NAERLS	National Agricultural Extension and Research Liaison Services
NBS	National Bureau of Statistics
NEEDS	National Economic Empowerment Development Strategy
NEPAD	New Partnership for African Development
NFDP II	National Fadama Development Programme II
NGOs	Non-Governmental Organisations

NPC	National Population Commission
OECD	Organisation of European Cooperation and Development
PPP	Purchasing Power Parity
RBDAs	River Basin Development Authorities
SEEDS	State Economic Empowerment Development Strategy
SIA	Social Impact Assessment
SPSS	Statistical Package for Social Scientists
SRLF	Sustainable Rural Livelihood Framework
SRRBDA	Sokoto Rima River Basin Development Authority
UBRBDA	Upper Benue River Development Authority
UNDP	United Nations Development Programme
UNICEF	United Nations Childrens' Emergency Fund
USAID	United States Agency for International Development
VCD	Video Compact Disc
USA	United States America
WUAs	Water Users Associations
WRI	World Resources Institute

ABSTRACT

The overall objective of this study was to analyse the impact of Hadejia Valley Irrigation Project (HVIP) on crop productivity and poverty reduction in the study area. The specific objectives were to: Describe the socio-economic and institutional characteristics of beneficiaries and non-beneficiaries of the Project; Analyse the impact of the Project on access to irrigation water between beneficiaries at head, middle and tail-ends of the Project; Evaluate the impact of the Project on cropped area under irrigation activities of beneficiaries and non-beneficiaries; Determine the impact of the Project on the poverty status of beneficiaries and non-beneficiaries; Assess the determinants of poverty among beneficiaries and non-beneficiaries; and Identify constraints faced by the beneficiaries and non-beneficiaries in the implementation of the project in the study area. The theoretical framework underpinning this study was the Social Change Theory and the Perspectives on Social Impact Assessment Out of a list of 7036 respondents, 207 beneficiaries and 146 non-beneficiaries were selected using a multi-stage random sampling making a total of 353 as the sample size of the study. Data were obtained using a structured questionnaire, analysed by descriptive statistics, t-and F tests and P-alpha poverty measures (Foster-Greer-Thorbecke Index) method. The results showed that with exception of off-farm income that ranged from a mean of ₦ 137, 797 = 00 and ₦ 237, 104 = 00 Naira and cost of hired labour of ₦ 33,641 = 00 and ₦ 55, 709 = 00 Naira all other measured characteristics of Beneficiaries were greater than that of Non-beneficiaries. However, the results of t-test on access to irrigation water were significant between head, middle and tail-end at 0.05%. The mean cropped area under irrigation activities of beneficiaries was significantly different from that of non-beneficiaries. The calculated $F_{(1, 410)}$ value (225), exceeded (F critical = 3.86), showed a highly significant difference between beneficiaries' and non-beneficiaries' crop productivity. Equally, the calculated $F_{(1, 410)}$ value (726.3) exceeded (F critical = 3.86), so there was highly significant difference in terms of net farm income between beneficiaries and non-beneficiaries. The mean employment opportunities between beneficiaries were significantly different from that of non-beneficiaries. The poverty measures indicated that 17% of beneficiaries were classified to be living below the poverty line of ₦ 12,489.00 while 36% of non-beneficiaries lived below the poverty line of ₦ 9,961.20. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for non-beneficiaries respectively. This meant that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them up to the poverty line. Similarly, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries. Among the list of constraints that posed threats, beneficiaries and non-beneficiaries perceived environmental, physical, health, crop-related and institutional risks as causes of the general constraints they faced. Consequently, from the results of the t-and F-tests and Foster-Greer-Thorbecke index, it was concluded that Hadejia Valley Irrigation Project had impacted on crop productivity and poverty reduction among its beneficiaries. It was therefore, recommended that government should encourage productivity and access in both farm and non-farm occupations; The project authority should have a uniform water fee collection policy; government should intensify family planning services efforts and activities; the project authority should address inadequate access to extension; Project beneficiaries should form farmers' cooperatives; the project authority to promote cost-saving and appropriate technologies.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The development of water resources especially for irrigation in Nigeria dates back to the pre-colonial era. Erratic and low rainfall, recurrent droughts and rapid population growth have all combined to make irrigation an essential factor in the food security strategies of Nigeria. As FAO (2003) observed the African continent in particular has very high spatial and temporal variability in rainfall compared to other continents. Consequently, irrigation agriculture has played a major role in expanding the level of food production, leading to the attainment of food sufficiency and overall agricultural development in some developing countries (Ibabu *et al*., 1996).

In addition to reducing the uncertainty in yields of rain-fed crops due to climatic variability, irrigation farming has contributed to general increase in crop productivity by enabling the use of high-yielding varieties of seed and chemical fertilisers (Frederick, 1992). It has also been instrumental to the economic development of many countries and has been a powerful means of generating income and creating employment during the dry season and all year round.

In Nigeria, the conception of large irrigation projects in the Hadejia area came as a result of a study conducted in the mid-1960s by the United States Bureau of Reclamation which was financed by the United States Agency for International Development (USAID). One of the analyses included the possibility of construction of several dams on rivers that drain the upper reaches of the Chad Basin through the Hadejia and the Yobe Rivers into Lake Chad (MANR, 1975). Moreover, the structural property of the Hadejia Valley

Irrigation Authority (HVIA) which lies in the North-Eastern Kano State (now in Jigawa State) is a natural advantage for large irrigation project. The valley is about 5 miles wide and 20 miles long and lies between the Hadejia and Kafin Hausa River loop.

The Hadejia River is the valley's northern boundary while the Kafin Hausa River borders the southern part (MANR, 1975). The valley area covered slightly more than 28,340ha (70,000 acres). Land formations within the project area, such as land dunes, lake bodies, and swampy areas as well as villages reduced the farming area to approximately 24,300ha (60,000 acres) (MANR, 1975). During the Third National Development Plan (1975-80), the need for rapid production of food and industrial raw materials became obvious in the face of rapidly growing population and the experiences of devastating droughts. It was in this context that "River Basins" concept came to be adopted (Lawal *et al.*, 2007).

Accordingly, the Hadejia Valley Irrigation Authority (HVIA) was taken over by the Hadejia- Jama'are River Basin Development Authority (HJRBDA) from the Ministry of Agriculture and Natural Resources (MANR), Kano State in 1976. The location of Hadejia Valley Irrigation Authority continued to be maintained as done by the MANR but the original plan of small schemes operated by the ministry was renamed Hadejia Valley Irrigation Project (HVIP) and consolidated into two Phases (I and II) (HJRBDA, 2012). Operationally, Hadejia-Jama'are River Basin Development Authority (HJRBDA) covers areas in Kano, Jigawa, and Bauchi States with a potential irrigable space of 250,000 hectares. The objectives of the authority among others include: harnessing, conservation, and efficient utilization of available water resources within its area of jurisdiction for increased agricultural production and domestic water supply.

As reported by Lawal *et al*. (2007) the HJRBDA has made a remarkable progress in executing its set objectives in all its project sites and locations. The authority has been able to maintain and repair most of its irrigation facilities to make fields workable and productive each season while some new project designs continue to emerge. Irrigation projects in Nigeria, like in many other developing nations are pursued with the objectives of boosting agricultural production and improving livelihoods of dwellers in the areas where they are constructed.

However, Musa (2004) pointed out that there may be some conflicting interests between farmers, government and the environment, especially when most decisions affecting farmers overlook their felt needs and priorities. These conflicting interests thus, distort planned systems and the impact on farmers or the community could be negative. He therefore, argued that it is not sufficient to assume direct beneficial impact of all irrigation projects, but attempts should be made to determine the magnitude of such impact on other variables. This argument by Musa (2004) provided the basis for this study. Specifically the study assessed the impact of Hadejia Valley Irrigation Project (HVIP) on crop productivity and poverty reduction in the study area.

1.2 Problem Statement

In Nigeria, agricultural policies have generally followed the path of modernism, that is the desire to break up with the past (traditional agriculture) which is considered to be archaic and unproductive. Agricultural modernisation was and is still regarded as the key to achieving food security and economic growth. Previous policies and programmes targeted at improving the productivity of farmers relied on technical assistance through the provision of external inputs such as fertiliser, herbicide, insecticides and hybrid seeds.

Others include: large-scale irrigation schemes such as Hadejia Valley Irrigation Project (HVIP) aimed at transforming small-scale agriculture to commercial farming. As such, the Federal Government of Nigeria (FGN), various other international donors and bilateral organisations have invested extensively in the Public Irrigation Sector but, it accounts for only 13% of the irrigated area and an estimated 0.25% of total agricultural area (Enplan Group, 2004).

However, irrigation attracts debate on how it supports intensification and pathways out of poverty, or drives commoditisation and differentiation (NEPAD, 2002). Modern irrigation technologies have been an important tool and force within these wider modernisation and transformation plans. As a result, in Nigeria export agriculture becomes well-established at the expense of national food self-sufficiency. The effect of these policies is that research and extension have targeted and served the interest of the 'modern' agriculture and the 'modern farmer' instead of improving the indigenous practices of the smallholder farmers. Generally, these policies have not resulted in long-term sustainability and food self-sufficiency, nor have they led to poverty reduction, especially among Nigeria's teeming rural populations.

Moreover, the effects of these various intervention measures include: the erosion of sustainable traditional farming practices (intercropping, mixed cropping, integrated farming, and use of organic manure), extensive adoption of agro-chemicals, the attendant environmental consequences and food scarcity as a result of emphasis on crops for the market beside food crops. Farming systems that dwell more on export crops and agricultural commercialisation are generally given priority over smallholder, family-based production capacities despite their predominance in the food production chain.

Therefore, faced with the dual problem of structural poverty and hunger, aggravated by the pressures mentioned above, irrigators in Northern Nigeria are continually seeking new ways to survive and protect their livelihoods.

Small and Svendsen (1992) reported a dearth of knowledge about socio-economic transformations within irrigation systems and particularly suggested the need for more research on how agricultural technologies are related to these processes of change. Also, the need to know more about the interrelationships of these technologies with local forms of production and wider processes of change to understand what makes interventions fail or (conversely) useful for users as well as governments. In addition, hydrological processes are often more complex because of extensive interactions between water, ecosystems and people. Control and use of water upstream often impacts downstream users. Thus, irrigation provides an excellent example of how Nigerian farmers meet the challenges of production in agriculture in an ever changing environment.

Conversely, poor households are more in agricultural occupation and participation in agriculture is found to be more predominant in rural areas where majority are farmers. For many households in Nigeria, especially in the rural areas, agriculture is the main activity, and previous and current analysis of poverty has shown that poverty is disproportionately concentrated among households whose primary livelihood lie in agricultural activities (Federal Republic of Nigeria, 2007). Understanding the factors underlying the persistent deprivation of rural farming households is important, when designing policies to meet their needs and improve their welfare.

Therefore, given the diverse agro-ecological and socio-economic environment, dearth of information on the impact of HVIP and its association with household characteristics it is therefore, crucial to understand the impact of Hadejia Valley Irrigation Project on farm household characteristics, on access to irrigation water, cropped area under irrigation activities, poverty reduction and constraints faced in the implementation of the Project.

This study aimed to fill this important gap in irrigation-poverty literature in terms of clarifying the contribution of the HVIP on crop production and poverty reduction by analysing its impacts between beneficiaries and non-beneficiaries in the study area. The study provided answers to the following research questions:

i. What are the socio-economic and institutional characteristics of beneficiaries and non-beneficiaries of the Project?
ii. What is the impact of the Project on access to irrigation water between beneficiaries at head, middle and tail-ends of the Project?
iii. What is the impact of the Project on cropped area under irrigation activities of beneficiaries and non-beneficiaries in the study area?
iv. What are the poverty status of beneficiaries and non-beneficiariesin the study area?
v. What are the determinants of poverty among beneficiaries and non-beneficiariesin the study area?
vi. What constraints are faced by the beneficiaries and non-beneficiaries in the implementation of the Project?

1.3 Objectives of the Study

Overall objective of this study was to analyse the impact of Hadejia Valley Irrigation Project (HVIP) on crop production and poverty reduction in the study area. The specific objectives were to:

i. Describe the socio-economic and institutional characteristics of the beneficiaries of Hadejia Valley Irrigation Project;
ii. Analyse the impact of the Project on access to irrigation water between beneficiaries at head, middle and tail-ends of the Project;
iii. Evaluate the impact of the Project on cropped area under irrigation activities of beneficiaries and non-beneficiaries in the study area;
iv. Determine the impact of the Project on the poverty status of beneficiaries and non-beneficiaries in the study area*;*
v. Assess the determinants of poverty among beneficiaries and non-beneficiaries; and
vi. Identify constraints faced by the beneficiaries and non-beneficiaries in the implementation of the project.

1.4 Justification of the Study

The significance of irrigation for food production and economic development, as well as the need for sustainable development of the agricultural sector make this study valuable. Equally, imperative is the ecological implications of irrigated areas. Nigeria has relatively rich water resources, and its irrigation potential estimated that of the 3.14 million hectares of irrigable land area, only about 220,000 hectares (7 percent) was utilised which provided a source of livelihood to irrigation farmers (Akinyele, 2009).

However, despite huge potential for increased agricultural productivity, irrigation areas are fragile and the manner in which they are utilised has very important environmental and health ramifications because of the high levels of underground and surface water in those areas. This study is important because it focused on irrigation farmers, which were one of the most persistent groups in Nigeria. Additionally, the study was significant given the increasing pressures on agricultural lands in Nigeria due to factors that include: climatic changes (for instance drought and erratic rainfall), rising food prices, environmental risks associated with conventional agriculture.

In this study, conventional agriculture was used synonymously with modern agriculture which referred to an “industrialised agricultural system characterised by mechanisation, monocultures, and the use of synthetic inputs such as chemical fertilisers and pesticides, with an emphasis on maximising productivity and profitability. As pointed out by Jake (2011) industrialised agriculture became “conventional” only within the last 60 or so years (since World War II).”

Thus, this study investigated impact of irrigation agriculture on crop productivity, poverty reduction and the constraints facing irrigators using conventional agriculture.The present study moreover, focused on the Stage I of the HVIP two phases. The reasons for the selection of Stage I were: a) 50% activities of Stage I have been completed and it is imperative to study the socio- economic impact of such project after its full fruition and its impact, b) Stage I was totally irrigated by the HVIP system and the area under command of Stage I was a socio-cultural enclave and its value system was embedded in history. Therefore, the radical changes in socio-economic indicators were measurable.

Besides, a more balanced view of the contribution of irrigation related activities to changes, both in the irrigated command area and at a wider basin level, was therefore required. This implied assessment of impacts in the study area; the direct impacts of the construction, subsequent operation and maintenance of irrigation via access to irrigation water, cropped area under irrigation activities, crop productivity, income, employment opportunities and poverty reduction were assessed between beneficiaries within the command area and non-beneficiaries downstream. The indirect impacts of irrigation development through constraints faced by beneficiaries were through its net effects on farming. This required assessment of the "without irrigation project scenario" (i.e, the non-beneficiaries) that was adopted.

This study was undertaken to compare beneficiaries and non-beneficiaries of HVIP using proper statistical methods, techniques and econometric models. The introduction of these techniques should raise the status of this research, the procedure and process should equally be useful in the empirical analysis of the data base and to provoke further research in line with the design. The investigation should be of much utility for researchers, economists, academic, policy makers and implementers, extension and farmers in irrigation agriculture in Nigeria.

1.5 Research Hypotheses

The following hypotheses were tested in the research work:

H_{O1}: There was no significant impact of HVIP on access to irrigation water on beneficiaries at head, middle and tail-end areas of the Project.

H_{O2}: There was no significant impact of HVIP on cropped area under irrigation activities of beneficiaries in the study area.

H_{O3}: There was no significant impact of HVIP on poverty reduction among beneficiaries and non-beneficiariesin the study area.

1.6 Scope and Delimitation of the Study

This research addressed the impact of Hadejia Valley Irrigation Project on crop productivity and poverty reduction among beneficiaries and non-beneficiaries in Jigawa State from a social perspective. This was done with special reference that Nigeria being agrarian and agriculture remained the hub of the economy, providing employment for over 90 percent of the rural dwellers, who constituted about 70 percent of the total population. It was also, estimated that of the 3.14 million hectares of irrigable land area, only about 220,000 hectares (7 percent) was utilised which provided a source of livelihood to irrigation farmers (Akinyele, 2009). Thus, this research sought new insights into the impact of irrigation agriculture on crop productivity and poverty reduction among beneficiaries and non-beneficiariesin developing countries like Nigeria.

This study hoped to contribute to the debate on the impact of irrigation Project in Nigeria. The study focused on Jigawa State in the savannah region of Northern Nigeria and explored the farming practices of both beneficiaries and non-beneficiaries of Public Irrigation Project in light of biophysical/social factors with the purpose of ascertaining its impact. In general, this study investigated modernisation and agricultural policies pursued in Nigeria. Government strategies for agricultural development were reviewed with the specific aim of showing the policy direction of the Nigerian government in relation to irrigation Projects and modernisation of agriculture. Some of the policies reviewed include: the building of dams for irrigation purposes and if these measures have led to substantial increase in crop productivity and poverty reduction among beneficiaries and non-beneficiaries.

However, some of the limitation of this study was the method employed in data collection. For an effective assessment of the impact on beneficiaries' crop productivity and poverty reduction, information on production record before and after the Project was needed and this was obtained mainly through interviews since secondary data which would have serve as the baseline was not available. This posed a great limitation because of reliance on farmers' memory recall abilities, integrity and considering the variation in time period before and after the Project. Also, this study was not able to assess the spill-over effects from other previous agricultural development Project interventions due to time and financial constraints. As such, the results of this research should be complemented with results from other areas measured at different periods of time to obtain a broad and generalised picture of impact of HVIP on crop productivity and poverty reduction among its beneficiaries.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background of Hadejia Valley Irrigation Authority (HVIA) 1975-1980

The Hadejia Valley Irrigation Authority (HVIA) area lies in the North-Eastern part of the then Kano State and runs in a north-east direction. It was about 5 miles wide and 20 miles long and lies in the area between the Hadejia River and its Kafin Hausa River loop. The Hadejia River forms its northern boundary while the Kafin Hausa River forms its southern boundary (MANR, 1975). The Hadejia Valley Irrigation Authority (HVIA) was taken over by the Hadejia Jama'are River Basin Development Authority (HJRBDA) from the MANR, Kano State in 1976.

Furthermore, Ministry of Agriculture and Natural Resources pointed that apart from earlier studies to determine urban water sources for the city of Kano, little research data for the time prior to the mid-1960s was available on the Kano River, Challawa River, and the Hadejia River. As such, the FAO and USAID agricultural survey of the northern region of Nigeria carried out in 1960, recommended a formal technical study of the Chad Basin to determine the best use of both surface and groundwater. Agricultural development in Nigeria 1965-1980 published by FAO suggests that the Kano River, the Chalawa River and the Hadejia River are large enough for development of several irrigation schemes (MANR, 1975). The report was sub-divided thus:

A. Irrigation

Kano State has had traditional irrigation systems of the Shadoof type. Irrigation of this type was limited to shallow lifts of water from wells and from rivers by counter-balancebooms.These systems served the hectarages of individual farmers which were very small, and generally limited to vegetables, although some grain were also grown. Some of the Shadoof projects progressed to small gasoline or diesel-powered pumps. Also, irrigation projects organised and supervised by the MANR of the Department of Irrigation have existed for more than 10 years. In Hadejia area itself, there were a number of projects managed by the Ministry of Agriculture and Natural Resources (MANR, 1975).

Farmers generally held 1 acre in the projects at Agubu, Arawa, Ganuwar Kuka, Mai Alkama, Sunamu, Tashena and Yamidi. The expansion of these projects was limited to less than 400ha (1000 acres) because the Hadejia River has a very small flow in the months during which wheat is grown from November and December to March and April. In such schemes, the State provided mechanical seed-bed preparation and water pumping. The farmers provided the labour for irrigation, purchased the fertilizer and harvested the crop. The State guaranteed a minimum price for the wheat grown. The farmers involved in these projects adhered to strict schedules for irrigation. But, it appeared that enough water was not available to saturate the field capacity properly so that production generally averages 1,900 kg/ha (2,000lb/acre). Further, water supplies generally dwindled before the wheat was matured (MANR, 1975).

B. Drainage and Flood Control

i. Irrigation Administered by the Government

The government schemes were broken into 1 acre plots. Allocation of these plots was done by the administrator of each scheme. Each participating farmer normally received 1 acre but ambitious farmers sometimes received 2 or 3 acres. Many of the farmers in the schemes inherited rights to the land they cultivated but they were required like other farmers to follow cultural practices as prescribed by the extension agents and paid fees for tillage and water. Failure to do so gave the project the right to reallocate the land to other farmers (MANR, 1975).

ii. Project Description

As reported by MANR (1975), the project area was near the village of Hadejia in the north eastern quadrant of Kano State, Nigeria at latitude 12^0 12' north and longitude 10^0 04' east. The area covered slightly more than 28,340ha (70,000 acres). Land formations within the project, such as land dunes, lake bodies, and swampy areas as well as villages, reduced the farming area to approximately 24,300ha (60,000 acres). The project was concerned with:

a. Building engineering works for irrigation,

b. Land development, including clearing and leveling,

c. Operation and maintenance of equipment for land preparation and production, and

d. Establishing ancillary services such as food processing plants.

iii. Development

The MANR (1975), pointed out that the project was planned to develop over a period of 8 years as follows:

Two years of pre-implementation preparation

First year	1,620 ha	(40,000acres)
Second year	3,240	(80,000acres)
Third year	4,860	(12,000acres)
Fourth year	4,860	(12,000acres)
Fifth year	4,860	(12,000acres)
Sixth year	4,860	(12,000acres)

Each phase of the project was to be developed for village and corporate farming. Management of the entire area, the canals, and land clearing was to be directed by the project organisation. Once the area was ready for irrigation, the village farm portion was to be sub-divided for individual farm allocation. During the first rainy season after project initiation the village farmers were to be permitted to grow traditional crops, if they desired. The corporate farm areas were to grow cash and food crops specified. In the following dry season all of the area was to be devoted to cash and food crop production.

Corporate farming was to involve the close management of large tracts of land. Usually these tracts would be managed by private producers under leases from the Hadejia Valley Irrigation Authority. Under village farming, villages or individual farming would result in decreased cultivation and need for mechanical inputs and might generally inhibit the efficiency of overall management. Eventually, as the project progresses it was anticipated that in the rainy season cash crops would be grown on the village farms and villagers would then purchased their food crops from outlaying area. If sufficient water was available, yields from crops in the dry and wet seasons were expected to increase gross income up to forty times in the project area. Increased production was expected to provide further employment to the population in the area (MANR, 1975).

2.2 Background of River Basin Development Authorities (RBDAs)

Prior to 1960 in Nigeria, water resources development was the preserve of private individuals and groups. The government's major intervention came during the first National Development Plan (1962–1968) through the establishment of the River Niger and Lake Chad Basin Commissions. The commissions were then mandated to produce hydrological maps of the country's water resources, use the maps to fashion out a comprehensive development of agriculture, fisheries, animal husbandry and navigation (particularly along River Niger)(Handidu,1990). Handidu (1990) further pointed out that this was followed in 1973 and 1974 with the establishment of Sokoto-Rima and Chad Basin Authorities and subsequent increase of the number to eleven River Basin Development Authorities in 1976 to cover the whole country.

The River Basin Development Authorities (RBDAs) were charged with the responsibility of a comprehensive water resources (surface and groundwater) development of Nigeria for multipurpose uses. In 1984, the RBDAs were increased to eighteen (18) and redesignated River Basin and Rural Development Authorities (RBRDAs) with similar functions to the RBDAs. With the change of the Military Administration in 1985, the number (18) was scaled down to eleven and retained the name RBDA, and its function limited to purely water resources development.

Other Agencies were also created both at the federal and state levels to take charge of specific water resources activities. The Nigeria Dam Authority was created for hydroelectric power generation as Kainji Federal Inland Waterways Division (of the Federal Ministry of Transport) for data collection and development of the Niger and Benue River Systems for water transportation (Handidu, 1990). He also, observed that the Water Boards/Corporations/Utilities were established at regional (and later State) levels to take care of water supply to the people, particularly in the urban and semi-urban areas. In the 80s, some other Agencies have been established to support existing ones so as to increase water resources development particularly in the rural areas. The Agencies include Directorate of Food, Roads, and Rural Infrastructures (DFRRI); Agricultural Development Projects (ADP's) which have water supply components in their functions; non-governmental organisations (NGOS) like FAO, UNICEF, UNDP, etc.

Based on this, Decree Number 25 of 1976 divided the country into eleven (11) river basins, each under the administration of a River Basin Development Authority (RBDAs). These are:

a. the Sokoto –Rima River Basin Development Authority;
b. the Hadejia Jama'are River Basin Development Authority;
c. the Chad Basin Development Authority;
d. the Upper Benue River Basin Development Authority;
e. the Lower Benue River Basin Development Authority;
f. Cross River Basin Development Authority;
g. the Anambra River Basin Development Authority
h. the River Niger Basin Development Authority;
i. the Ogun-Osun River Basin Development Authority;
j. Benin-Owena River Basin Development Authority;
k. the Niger Delta Basin Development Authority; (RBDA Decree 87, 1979).

2.3 Hadejia Valley Irrigation Project (HVIP), Phase I, Stage I, 1981-2012

The Hadejia Valley Irrigation Authority (HVIA) was taken over by the Hadejia Jama'are River Basin Development Authority (HJRBDA) from the MANR, Kano State in 1981. The location of Hadejia Valley Project was maintained as earlier carried out by the MANR, but the original plan of small schemes operated by the ministry was consolidated into two Phases (HJRBDA, 2012). Phase I lies within Auyo, Kaugama, Miga and Kafin Hausa Local Government Areas of Jigawa State in Hadejia Emirate between the Hadejia River and its branch, the Kafin Hausa River. Hadejia Valley Irrigation Project (HVIP) is a multi-purpose project and involves the land, water resources and irrigation development to enhance agricultural production in the predominantly farming communities within the Project area.

The project was designed in such a way that water released from the upstream Challawa and Tiga dams into the river system could be used for irrigation. A barrage/storage pond was constructed to store the water and from there the water is diverted through water control structures into the irrigation canals of the project (HJRBDA, 2012). Originally, the project was contracted in 1981 for the development of the whole of Phase I, which comprised of about 12,500hectares of farmlands. At the restart of the works in 1992, the original contract was divided into two Stages (Stage I and Stage II). The contract was for the construction of the Hadejia Valley Project, Stage I of Phase I which involved the development of 19 sectors with a net area of about 6,109hectares of farm land (HJRBDA, 2012).

2.4 Socio-Economic Characteristics of farmers in Irrigation Projects

According to Mohammed *et al.* (2009) studying the Upper Benue River Development Authority (UBRBDA) showed that the minimum, maximum and mean ages of the respondents were 40.00, 69.00 and 59.84 years respectively. This means that both were within the agricultural productive age range of 30–55 years quoted by food and agriculture organization (FAO, 1992). Also, most studies dealing with agricultural production argued that schooling or the level of education of a farmer helps the farmer in the use of production information leading to increased yield. Pudasaini (1983) documented that education contributed to agricultural production in Nepal via the farmers' knowledge and allocated effects.

Reporting on sex, Makombe and Sampath (2003) found within some schemes that male operated farms out performed female operated farms. In South Africa, Perret (2002) argued that this was because females had many other obligations preventing them from intensive fieldwork.In another study of Indian farmers, Sharman *et al.* (2003) reported that all respondents' family was male-headed with an average family size of 6 members per household. Family size did not vary significantly across the regions where the study was conducted. Larger family sizes might play a significant role in provision of family farm-labour which helps to reduce expenditure on production, but increased costs of expenses on the family. The larger sizes of families discovered in this study could go a long way in assisting the high-aged respondents to continue operating (Murtala *et al.*, 2004).

A study by Ogundele and Oruruwa (2004) showed that farm size significantly determines levels of technical efficiency in Nigeria. However, according to Chang and Boisvert (2006) the reliance on income from the non-farm sources by farm households has continued to narrow the gap between incomes obtained by farm and non-farm households. For example, DFID (2004) reported that as much as 60 percent of an average Nigerian farm household's cash incomes were derived from non-farm activities with an average of 36 percent adult working hours devoted to non-farm activities.

In Africa and Nigeria, indeed, farm labour is usually provided by the family. Hired labour is regularly used to augment family labour. In this regard, Adegeye and Dittoh (1985) observed that in Nigeria although three types of labour could be distinguished that is, family, hired and exchange labour, family labour is the major source. They further, pointed out that family labour is predominantly used in Nigeria and it comprises the labour of all males, females and children in the family or household because they participated in the cultivation of the household activities.

Moreover, 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 view was 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. But, the mean of 26.63 years of experience in rice production was also much higher than 10.8 years found by Umoh (2006) and Idiong *et al.* (2006) among rice farmers in Cross Rivers State of Nigeria. Experience in farming activities plays an important role in decision-making relating to output increase and risk avoidance (Mohammed *et al.*, 2009).

Attempts to establish WUAs elsewhere – such as at KRIP (HJRBDA), Wurno (Sokoto State), LAIP (AIRBDA) and Bakolori (SRRBDA) – brought little success: they have either dissolved or live on without performing any useful function. The non-effectiveness of the WUAs could be attributed to the constraints faced by the RBDAs and as such there were no incentives for WUAs to succeed (Enplan Group, 2004). Conversely, for farmers to support a WUA the benefits must outweigh the costs – in terms of their time, materials, cash and interpersonal transactions–that membership involved.

Previous studies (Nambiro, 2008) starting with the von Thunen model of 1826 have commented extensively on the influence of location as measured by the remoteness or otherwise of farm locations to farmers' homestead, cities or commercial centers on land use pattern. In a similar study, Jelili *et al.* (2011) observed that farmers in the low intensity group cultivated farmland that were farther away from their residence (5.75km) than farmers in the medium (2.92km), high (4.89km) and very high (3.62) intensity categories. In the same vein, farmers in the low intensity category also had their farm located farther away from the major market (15.75km) than farmers in the medium (6.54km), high (9.77km) and very high (6.40km) categories. Finally, farmers in the high and very high intensity categories engaged in lower crop diversification index of 0.47 and 0.49 respectively compared to the crop diversification index of 0.61 estimated for farmers in the medium intensity category.

Further, Gregory (2006) reported that fertilizer subsidies for staple crops were a critical requirement for the Green Revolution process in Africa. Dorward *et al.* (2004) also argued that sustained (but not indefinite) input subsidies were a major part of successful Green Revolution packages making a critical contribution to thickening and thus 'kick starting markets' first within staple food supply chains and then in the wider rural economy. They identified these as potentially the major pro-poor growth outcomes of a long-term consistent input subsidy programme in Malawi (Dorward *et al.*, 2007).

With access to credit, many Nigerian farmers might be able to realise higher returns from irrigation farming. Credit plays an important role in increasing agricultural productivity. Timely availability of credit enables farmers to purchase the required inputs and machinery for carrying out farm operations (Saboor *et al.*, 2009). Also, Owen *et al.* (2001) investigated the impact of farmers' contact with agricultural extension services on farm productivity and the results showed that access to agricultural extension services, defined as receiving one or two visits per agricultural year, raised the value of crop production by about 15 percent. Agricultural extension represents a mechanism by which information on new technologies, better farming practices and management could be transmitted to farmers.

2.5 Water Management in Nigeria

According to Goldface-Irokalibe (2008) for many years the lack of an overall water policy in the form of strategies, functional national water master plans, proper mechanisms for intersectional coordination, tariff setting and conflict resolution has meant that the responsibility for water management for each segment of water use remained diverse and diffused. Different agencies at all tiers of government (federal, state and local government) pursued different water agenda, which made water development policy decision such as abstraction, pollution control, and watershed management highly fragmented.

A. Customary Law

In all native communities in Nigeria, there are customary laws relating to water rights. Rules and regulations are known to, and observed by all and sundry. These laws are handed down orally from generation to generation. The pristine antiquity of these laws and their observance to this day is of remarkable significance especially against the background of these customary laws being legislative in effect (Goldface-Irokalibe, 2008). Further, Goldface-Irokalibe (2008) observed that under customary laws the common notion is that water courses or water bodies in any community, like the classification under Roman law, is *res omnium communes* or a resource common to all, subject to community control and not capable of being privately owned.

B. Federal Laws

From the federal standpoint there are three pieces of post-colonial legislation that formed the core of water laws and the basis of water law administration throughout Nigeria. The relevant laws are: River basin Development Authority Act, 1976, Water Resources Act, 1993, and the Environmental Impact Assessment Act, 1992. These laws form the normative core whilst relevant rules and provisions could be found in a variety of sources including constitutional law, land law, and mining law. The Water Resources Act, 1993 vested ownership of all water courses affecting more than one state of the federation, as well as all underground water throughout the federation in the federal government of Nigeria.

2.6 Impact of Irrigation Projects

Like most projects, irrigation has a wide range of beneficial and harmful effects on the environment. The beneficial effects often reflect on the welfare gains by farmers due to increased crop output and the multiplier effect of this on national income and food security. On the other hand, its numerous deleterious effects have been documented as either 'on-site' or 'off-site' effects (WRI, 1992). Bhattarai, *et al*. (2002) reported that the total beneficial impacts of irrigation development, both direct and indirect, can be summarised under the following categories:

a) Increased crop production (yield improvement) and increased farm income; b) Increased cropping intensity and crop diversification opportunities and the feasibility of year round crop production activities; c) Increased farm employment—more employment opportunities for farming families as well as for hired laborers in the locality; d) Increased farm consumption and increased permanent wealth (permanent asset accumulation due to irrigation). This has significant implications for reducing intrinsic food insecurity in a region; e) Reduced food (crop) prices allowing access to food for all, which is more beneficial to landless and subsistence families and provides better nutrition intake. This is also equally beneficial to urban poor and city dwellers, since they spend more than 50 percent of their daily income on food items; f) Reduced friction in the rural economy and reduced transaction costs including reduced farm marketing costs due to increased access to farm link roads and to other improved farm and non-farm related services in the region; g) Multiple uses of water for bathing, washing, livestock and home gardens; h) Increased recharge of groundwater, easy access to groundwater and less drudgery for women in fetching water for daily household needs, i) Aesthetic and recreational benefits accrue out of irrigation facilities; j) Increased farm income (for farmers) and increased farm and off-farm employment opportunities for rural landless labourers result in better school attendance of children of farm laborers and improved social capital in society. This is due to the income effects of irrigation, since education is a luxury compared to other basic needs: foods, clothes, shelter, health, etc; k) Export tax revenue accruing to government coffers; this is important particularly for the major agricultural (rice) exporting countries like Thailand, Vietnam, USA, etc.

2.6.1 Impact of irrigation on access to irrigation infrastructure

Access to irrigation provides farmers with reliable water source at critical times in the crop's life cycle, removing the dependence and inherent uncertainty of rain-fed and lake-based agricultural systems in arid and semi-arid regions. In the case of groundwater irrigation, it has also been observed that when there is short-term drought, investments in labour and related inputs would not be lost (Burke and Moench, 2000). Equally, Latif *et al.* (2009) proved that farmer's location on the irrigation network has significant impact on their income in spite of the fact that water rights were same for all water users. Accordingly, farmers located at upper reaches of the irrigation canals got higher income and it progressively decreased downstream. The author pointed out the difference in income was due to higher use of groundwater towards tail reaches, the reason being that pumping groundwater was very costly. Another issue of groundwater quality variation along the canals was analysed in the same study.

In addition, irrigation is considered a major means by which food production could be increased. Thus, the role of irrigation is crucial in the development of agriculture in Nigeria. In the past, analysis of irrigation service delivery has been undertaken at different points in time on different systems, following different methodologies. Opinion surveys have been used to quantify the opinion of the people. However, it has been pointed out that the quality of irrigation services should include components like adequate water supply to the entire command, timeliness of water supply, equitable supply across the command, accountability or the responsiveness of the staff towards the farmers and timely repair and maintenance of the irrigation infrastructure (Mohammed *et al.*, 2003).

2.6.2 Impact of irrigation on cropped area under irrigation activities

It is estimated that 88% of water in Africa is used for agriculture (Xie *et al.*, 1993). The area under irrigation is about 5.3 x 106 ha, of which 2.6106(53%) is for commercial or large-scale agriculture (Wyss, 1991). Although these figures give the impression that irrigation is relatively common in African agriculture, only 5% of total crop land is, in fact, irrigated compared with 29% for Asia (Grainger, 1990). This is to some extent a function of the peculiar geography of Africa, which include inaccessible aquifers in West Africa, making groundwater irrigation extremely expensive, and unreliable surface-water flowed elsewhere, making other kinds of irrigation highly risky (Grainger, 1990).

Four percent of total cultivated area is under irrigation in sub-Saharan Africa (World Bank, 2007) which suggests the potential effect that increased irrigation investment might have on agricultural productivity and poverty by expanding the number of total irrigated hectares. However, irrigation projects are not all uniformly successful over the long-term and differed along critical dimensions.

2.6.3 Impact of irrigation on crop productivity

Empirical evidences suggested that irrigation projects have positive impacts on agricultural production and the reduction of poverty for farmers (Lipton, 2007). Access to irrigation provides farmers with reliable water source at critical times in the crop's life cycle, removing the dependence and inherent uncertainty of rain-fed and lake-based agricultural systems in arid and semi-arid regions. This reduction in risk faced by farmers is likely not only to increase mean agricultural returns but, also to reduce their vulnerability to income fluctuations. While farmers are exposed to unforeseen production shocks regardless of the production system, irrigation minimises these shocks by permitting a wider range of ex post smoothing mechanisms to be used, which causes fewer distress sales of crop stocks or assets. Lipton (2007) reported that in India, irrigated areas had 2.5 times low standard deviation of crop output per year during the period 1971-1984.

Moreover, the direct benefits of irrigation development operate at local and household levels with higher production, higher crop yields, reduced risk of crop failure, all year-round and non-farm employment opportunities and food security. Globally, 17% of global irrigation land contributed to about 40% of world's cereal production (Lipton *et al.*, 2002). Therefore, agricultural productivity is one of the key determinants of high and sustained agricultural growth, and in fact a key determinant of its growth over the longer term. Faster agricultural growth has put countries on the path of a much broader transformation process: raising farm incomes, demand for industrial goods, lowering food prices, curbing inflation and inducing non-farm growth, and creating an additional demand for workers. Raising on-farm productivity also encourages broad entrepreneurial activities through diversification into new products, the growth of rural service sectors, the birth of agro-processing industries, and the exploration of new export market (World Bank, 2008).

2.6.4 Concept of poverty

Central to the quest for policies and programmes that will reduce poverty is the issue of the conceptualisation of poverty. Conceptually, three dominant views are identified as the meaning of poverty in the literature. The first view sees poverty as a severe deprivation of some basic human needs at the individual or household level. Put differently, poverty is a material deprivation and this can be assessed in monetary terms. While this conceptualisation of poverty makes the quantitative analysis of poverty straightforward and permits comparisons over time and between countries, it fails to recognise non-material forms of deprivation such as illiteracy and social discrimination among others. The second view has a direct link with the work of Sen (1999) and it defines poverty as the failure to achieve basic capabilities such as being adequately nourished, living a healthy life, possession of skills to participate in economic and social life, permission to take part in community activities to mention a few. This conceptualisation forms the basis for the belief that 'poverty is multi–dimensional'. Although, the capabilities framework offers many advantages over the income/consumption conceptualisation, yet it is argued that it requires a greater variety of data and that no consensus exists on how capability deprivation at the household level is to be computed.

The third conceptualisation of poverty came into limelight in the 1990s and has a fundamentally different approach to the understanding of poverty: subjective poverty assessments. The core of this view of poverty is that poverty must be defined by the poor themselves or by the communities that poor people live in. According to Chambers (1994) the view came out of the work on participatory appraisal of rural projects and has direct relationship with a publication known as ‘Voices of the Poor series’ which has three volumes: Can Anyone Hear Us?, Crying Out for Change, and From Many Lands. The subjective view of poverty is that, poverty has both physical and psychological dimensions. Poor people themselves strongly emphasise violence and crime, discrimination, insecurity and political repression, biased or brutal policing, and victimisation by rude, neglectful or corrupt public agencies (Narayan *et al.,* 1999). Karlsson (2001) presented five conclusions form the ‘Voices of the Poor Series”, these are:

a. Poverty needs to be viewed in a multidimensional way. Hunger is part of everyone’s understanding of poverty. Equally strong is the sense of powerlessness, voicelessness, and humiliation that comes with being poor.
b. The state has been ineffective. People everywhere fear police, they hate corruption, and they trust only their own institutions.
c. Non–governmental organisations play a limited role. People rely on informal networks.
d. Households are under deep stress. Gender relations are crucial to understanding poverty, particularly the position of men.
e. The social fabric is often poor people’s saving grace, and it is under threat.

The World Development Report (2000/2001) recognised many of the conclusions on the meaning of poverty and then develops three principles that directly augment what is known of poverty previously and how to attack poverty. These principles are:

a) Empowerment–with a pro–poor state and voice for the community,

b) Security–against natural disaster, war, violence, and unforeseen changes in income and health,

c) Opportunity–promoting assets and enhancing the return on them through public and private policies.

Given the present understanding that poverty goes beyond material and capabilities deprivation, it is acknowledged in the literature that business as usual will not eliminate or reduce poverty (Karlsson, 2001). In other words, poverty reduction requires more than just delivering money and advice. The World Development Report (World Bank, 2000) extends the concept of poverty beyond income and consumption plus education and health, to include risk and vulnerability, as well as voicelessness and powerlessness. It is not necessarily the case that shocks affect the poor disproportionately, but it is clearly the case that they are more vulnerable, since their economic margin is slim. The poor are often exposed to highly fluctuating incomes, and, particularly, in rural areas, it is common for households to move in and out of poverty (Dercon, 2000).

2.6.4.1 Measurement of poverty

Foster *et al.* (1984) reported that the most frequently used poverty measurements are: a) the Head Count Index, b) Poverty Gap Ratio, and c) Poverty Severity Index.

A. Poverty indicators

Traditional poverty analysis makes use of certain indicators. The most commonly used and understood is a poverty line.This has become the standard tool of policymakers for poverty monitoring. In a poverty line, people are counted as poor when their measured standard of living falls below a minimum acceptable threshold. There are various measures that can be used to define this minimum level of welfare and much controversy surrounds the choice of poverty line. Whatever methods used to define this threshold, the poverty line is a relatively arbitrary divider of poor and non-poor.

B. Objective measure of poverty (Food Energy In-take)

The goal of this method is to define the level of consumption that will enable the household to obtain enough food to meet its basic energy requirement. This approach computes the cost of acquiring a given food basket providing adequate calories for the individuals in the household. The following steps are used to compute the objective poverty line (FOS, 2005):

a) Compute a national food basket based on the consumption patterns of the poorest 40 percent of the population.
b) The bottom 40 percent is computed by dividing per capita expenditure into quintiles (20 percent brackets) and examining food preferences of the bottom two quintiles.
c) Compute the amount of food expenditure required to attain 2900 calories per day based on the national basket for the poorest 40 percent.
d) Food consumption is a function of age and sex composition of the household. Infants and younger children do not require the calorie intake that adults do.
e) A non-food component was added by examining the average non-food expenditure for those households (+ or – 100 households) around the core poverty line.
f) This is added to the food expenditure for a total expenditure threshold.

C. Dollar per day

The dollar per day has become an acceptable standard for measuring poverty across countries for international comparability. It is defined in terms of deflated Dollar per day.

This process of establishing parity in the acquisitive power of a Dollar is called Purchasing Power Parity or PPP (FOS, 2005).

D. Subjective measure of poverty

This method requires the individuals to assess what they consider to be a decent or minimally adequate standard of living. It is also known as a self-assessed level of poverty. This method is less widely used as people tend to over-state what they perceive to be a personal poverty level (FOS, 2005).

E. Relative measure of poverty

This is based on a measure of mean per capita household expenditure. The steps for computing this line were outlined below (FOS, 2005):

a) Aggregated and annualised food expenditures (food purchase and consumption of own produce).

b) Aggregated non-food expenditure. This included imputation of rental values for all categories of non-rented homes including: owner occupied houses, rent-free houses, subsidized housing, etc. A component of use value for assets is also included.

c) Obtain total household expenditure (Food + Non-Food). Since this measure includes imputed own produce and other items, the aggregate tends to measure welfare.

d) Compute per capita household expenditure: total household expenditure divided by the household size.

e) Sum all the per capita household expenditure across all the households and divide by the total number of households.

f) This gives the weighted mean per capita household expenditure.

g) Average per capita household expenditure.

h) The poverty line was based on 2/3 of the average per capita expenditure. All persons with per capita expenditure less than this amount are considered poor. Those equal to or above are non-poor.

i) A core poor (or extreme poverty) was defined as 1/3 of the average per capita expenditure. All persons with per capita expenditure less than this amount are considered extremely poor.

2.6.4.2 Causes of poverty

Poverty reduction is the most difficult challenge facing Nigeria and its people and the greatest obstacle to pursuit of sustainable socio-economic growth. Inadequate growth is the main cause of poverty in Nigeria. The lack of growth is compounded by the volatility of the oil sector, which affects a range of activities in the economy. Unemployment is an added problem, which has escalated the proportion of the poor. Other factors that have contributed to the evolution of poverty in the country include: problems in the productive sector, widening income inequality, weak governance, social conflict, gender, inter-sectoral and environmental issues (FOS, 2005).

2.6.4.3 Strategies of poverty alleviation

A. Pre-Structural Adjustment Programme

The activities include the provision of basic amenities such as social and economic infrastructure programmes to generate employment, enhance income earnings, increase productivity and those targeted at more equitable distribution of income. Others include increased production and supply of food, increased economic activities. These programmes were aimed at meeting the needs of the poor (FOS, 2005).

B. The Structural Adjustment Programme

According to FOS (2005) the Structural Adjustment Programme stressed greater realisation of the need for policies and programmes to alleviate poverty and provide safety nets for the poor.The programme failed because it had no human face in its implementation and it did not emphasize on human development which thereby aggravated socio-economic problems of income inequality, unequal access to food, shelter, education, health and other necessities of life. It ended up aggravating poverty especially among the vulnerable. Government efforts then could be categorised into nine groups: These were Agricultural Sector Programmes; Health Sector Programmes; Nutrition-related Programme; Education Sector Programmes; Transport Sector Programmes; Housing Sector Programmes; Financial Sector Programmes; Manufacturing Sector Programmes and Cross-Cutting Programmes.

C. Post-Structural Adjustment Programme, 1999-2007

Consequent upon the experiences of the past, the civilian government initiated anumber of programmes and policies directed at reducing poverty (FOS, 2005). The first programme was the Poverty Alleviation Programme (PAP) which was targeted at correcting the deficiencies of the past efforts at alleviating poverty through the overall objective of providing direct jobs for 200,000 unemployed persons and hence stimulates production within a period of one year. This programme later metamorphosed into the Poverty Eradication Programme (PEP) because of the need to improve participatory approach for sustainability, for effective coordination at all levels of government and proper focusing of the programme. The core programmes of Poverty Eradication Programme were Youth Employment Scheme; Social Welfare Services Scheme; Rural Infrastructure Development Scheme and Natural Resource Development and Conservation Scheme.The World Bank (2001/2002) later had to assist Nigeria in formulating poverty strategy programmes and policies through Interim Poverty Reduction Strategy Paper (IPRSP) with the aim of building on the gains of the earlier efforts on poverty programmes (PAP and PEP) (FOS, 2005).

In the face of the growing concern to sustain the gains of the poverty efforts, the present government came up with a comprehensive home-grown poverty reduction strategy known as National Economic Empowerment and Development Strategy (NEEDS) in 2004. The NEEDS also builds on the earlier two years' efforts to produce the interim PRSP. The NEEDS as conceptualised is a medium term strategy (2003-2007) which derives from the country's long term goals of poverty reduction, wealth creation, employment generation and value re-orientation. The NEEDS is a national coordinated framework of action in close collaboration with the state and local governments and other stakeholders. The equivalent of NEEDS at State and Local Government levels are State Economic Empowerment and Development Strategy (SEEDS) and Local Government Economic Empowerment and Development Strategy (LEEDS). The NEEDS, in collaboration with the SEEDS will mobilize the people around the core values, principles and programmes of the NEEDS and SEEDS. A coordinated implementation of both programmes will reduce unemployment, reduce poverty and lay good foundation for sustained development.

The main strategies of NEEDS are anchored on a tripod: Empowering People (Social Charter or Human Development Agenda); Promoting Private Enterprise and Changing the Way the Government Does its Work (Reform Government and Institutions). However, the social charter underpins the NEEDS programme. It is aimed at all aspects of the people's socio-economic life with the aim of reducing poverty and inequality. Despite her great natural wealth, Nigeria is still considered poor and social development is limited. If the present trends continue, the country is not likely to meet the Millennium Development Goals. Under NEEDS, reforms are ongoing in the key sectors of the economy with the objective of poverty reduction through anti-poverty programmes and policies. The positive effects of the reforms are gradually impacting on the people and efforts should therefore be continued for their sustainability and continuity.

2.6.4.3 Levels of poverty in the agricultural sector in Nigeria

Important determinants of living conditions of households and their members will be the economic activities in which they are engaged and the returns they are able to reap there from. For many households in Nigeria, especially in the rural areas, agriculture is the main activity, and previous and current analysis of poverty has shown that poverty is disproportionately concentrated among households whose primary livelihood lie in agricultural activities. Agriculture has been focused as a central element of Poverty reduction strategy. It is, therefore, important to understand the factors responsible for poverty in this sector.

Participation in agriculture was found to be more predominant in rural areas, with about 86 per cent of households engaged in the sector. On a zonal basis, most of the households participating in the sector were in the Northeast (30 per cent), while the Southwest had the least participation of 9 per cent. The Northern States were more engaged in agriculture than their Southern counterparts. A look at Northern States such as Benue (47 percent), Jigawa (38 percent), Borno (35 percent) and Southern States such as Lagos (0.79 percent), Osun (7.9 percent) and Ogun (9.9 percent) is revealing. (FOS, 2005).

2.6.5 Risks and vulnerability of farmers in irrigation projects

Addressing the issues of vulnerability has its advantages especially as it relates to poor rural households. For example, Alayande and Alayande (2004) opined that households face different kinds and magnitude of risk that might lead to a wide variation in their income from year to year including loss of productive asset. When there are not enough assets to reduce shocks or risk to livelihood, therefore, household sometimes could experience losses including reduction in the quality and quantity of nutritious food intake, or sometimes school-aged children might temporarily or permanently stop schooling which could reduce household human capital base. These losses could increase household risk and vulnerability to poverty.

Risk and vulnerability analysis among poor rural households according to some authors is important to an understanding of the social relations and decision-making processes that underlie households' livelihood diversification strategies (Ellis, 2000). It is also, increasingly recognised that the Nigerian economy is mainly made up of a rural agrarian sector with an increasing level of diversification either within or outside the agricultural sector (Omonona, 2009). The farm households might develop strategies for achieving these livelihood objectives. To increase food production, the farm households could seek to specialise and diversify both crop and livelihoods.

2.7 Constraints Faced by Farmers in Irrigation Projects

However, investment in hydraulic infrastructure, including large dams, is widely advocated as crucial for sustainable economic growth and poverty reduction in many parts of sub-Saharan Africa (World Bank, 2004). But, the cost these structures imposed is much more than financial. Inadequate consideration of both environmental and public health impacts could undermine the benefits to be gained from such investments (McCartney *et al.*, 2007).

2.7.1 Environmental constraints faced by farmers in irrigation projects

The introduction of irrigation in arid and semi-arid environments inevitably leads to water table variations and often to problems of waterlogging and salinisation. Nitrate resulting from nitrogen fertilizers used inagriculture is a widespread contaminant of groundwater and causes adverse effects on the health of humans, animals, and the ecosystem. Nitrates are not the only pollutants attributable to irrigation, so are plant nutrients in general, pesticides, and heavy metals. Pharmaceutical compounds emerged as pollutants when wastewater is used for irrigation without any previous treatment (Siemens *et al*., 2008).

Frequent drought and adverse economic conditions are 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-Andersen and Pandya-Lorch, 2001).

2.7.2 Health constraints faced by farmers in irrigation projects

Key among the potential negative effects of large dams is intensified malaria transmission, resulting from changes engendered by environmental and socio-economic transformations accompanying water resources development (Keiser *et al.,* 2005). Previous studies pointed out that the effect of irrigation on the incidence of vector-borne diseases depend on multiple factors, such as the epidemiologic setting, the ecology of the area, or the socio-economic status of the population (Wielgosz *et al.,* 2012). Although irrigation interventions could have many positive effects on health, its negative effects are also important for research. Irrigation schemes might affect the risk of vector-borne diseases, such as malaria, dengue, and schistosomiasis, because vector-breeding habitats might be altered by irrigation practices. Studies analysing the effect of irrigation systems on vector-borne diseases are numerous and the results depict a complex picture (Keiser *et al.*, 2005).

Also, in most West African cities, gaining access to low-cost but, high-quality irrigation water raises enormous difficulties (Barry, 2002). Faruqui *et al.* (2004) reported larger crops and reduced growth periods where wastewater was used and for lettuce, a higher insect resistance but also lower density and faster spoilage. In many cities like Dakar, Accra, Tamale, Kano and parts of Ouagadougou, the supply of vegetables largely depends on the availability of used water. Thus, farmers who wanted to escape poverty rarely complained about water quality although perception studies showed that farmers are well aware of different water qualities (Obuobie *et al.,* 2006).

Other, studies on negative outcomes of irrigation on health might also result from the increase use of complementary inputs, such as pesticides, fertilizers, and other chemical products, due to the higher-input intensity of irrigated agriculture. However, the number of studies addressing this issue is still limited. The most reported health problems associated with pesticide exposure include: neurological abnormalities, respiratory diseases, reproductive, endocrinological and dermal problems (Kesavachandran *et al.*, 2009).

2.7.3 Physical constraints faced by farmers in irrigation projects

Kudi *et al.* (2008) observed that the most important problems encountered by respondents in NFDP II were high cost of maintenance of irrigation facilities (36%), inadequate farmland for farming (35%) as most farmland were fragmented due to population pressure and inheritance system of land acquisition and insufficient inputs (23%) while time wasting in processing of grants/credit facilities and other problems were represented by 18.3% and 15% of the respondents respectively. When the farmers were asked how they think the problems could be overcomed and irrigation farming enhanced in the study area, their responses ranged from provision of capital, fertilizer, pesticides, drilling of boreholes etc.

Lim and Douglas (1998) emphasised that poverty in most rural areas is still a significant barrier for small farms. They stated for instance, the introduction of an engine-powered cultivator for rice production, even though farmers expressed their interests but, the cost of the machine was the major problem. Hence there was lack of sufficient labor for land use, intensification in the area. Insufficient funding of research, project activities and movement of senior research scientists from developing to industrialised countries have been the major constraint in developing countries. These have affected many projects intended to improve the livelihoods of farmers (MSIRI, 1994). Similarly, farmers were constrained by poor weed control, high costs and storage of inputs, lack of modern storage and processing facilities, plot fragmentation due to succession problems, urbanization pressure, and land speculation (MSIRI, 1994).

Conversely, Nigeria has three types of land markets: (1) a market for allocations of certificates of occupancy from the government (formal market); (2) a market for the transfer of land rights documented by certificates of occupancy (formal and informal markets); and (3) the market for land that has no certificate of occupancy (informal market). Almost all rural land is in this last category (Butler, 2009).

2.7.4 Crop-related constraints faced by farmers in irrigation projects

Findings of Ojei (2000) reported that Quela quela and Sudan golden sparrow (*Passer lutcus*) are the dominant pests in Sudan savanna of Nigeria.Weed-infestation inirrigated lands has become more complex because of multiple cropping in both the dry and wet seasons(Dadari, 1988). Siltation and *typha auralis* along the littoral edges are also fast taking over large areas of the wetlands blocking water channels, decreasing fishing areas and sedimentary river beds leading to secondary ecological succession to terrestrial habitats. Decreased processes have threatened the ecological system of the wetlands thereby disturbing the habitat and its hydrological regime. Unfortunately, typha reed germinates in waterlogged soils with thin layer of >30cm of water and can flourish even at periods of water stress and aridity (Goes and Zubudan, 1996).

2.7.5 Institutional constraints faced by farmers in irrigation projects

Irrigation farming is one of the most important rural development investments that could have both direct and indirect impacts on poverty and food security in semi-arid tropical countries (Bhattarai and Narayanamoorthy, 2004). Moreover, a study carried out by Fan *et al.* (1999) examining the linkages between government spending, growth and poverty in rural India, using state level data from 1970 to 1993 showed that government spending on productivity enhancing investments, such as irrigation, research and development in agriculture, rural infrastructure (including roads, electricity, and education) which target the rural poor, have all contributed directly to the reduction of rural poverty. The researchers found that irrigation development, in addition to raising agricultural productivity, also encourages private investment in these regions.

Kabre and Zabo (2001) identified some constraints associated with management of agricultural policies and programmes as lack of understanding of the socio-economic and socio-cultural elements of the communities or participants by the programme implementers which were lack of appropriate institutional framework and links between the government's agencies and research institutes charged with responsibilities. Various researches on constraints have identified a number of factors as to implementation of agricultural development programmes schedules. Morardet *et al.* (2005) pointed to inappropriate technology as hindrance in the transformation of many technologies to farmers practicing irrigation.

Anderson and Shimokawa (2006) called the agriculture sector a major driver of economic growth that providesa crucial foundation for economic growth in both agricultural and non-agricultural sectors.The agriculture sector's growth and development could help address major development constraints in developing countries, such as distributional issues and poverty reduction. Majority of empirical evidences seem to show that inadequate infrastructure or unreliable infrastructure services might constrain investments in productive capital, thus, leading to a restricted or reduced output. Generally, Anderson and Shimokawa (2006) maintained that deficiencies in transportation, energy, telecommunications, and related infrastructure translated into inefficient domestic markets with little spatial and temporal integration, low price transmission, and weak international competitiveness. They maintained that failure to invest in rural infrastructure would be a critical bottleneck for future growth in agricultural and economic output.

2.8 Summary of the Literature Reviewed

Background of Hadejia Valley Irrigation Authority (HVIA) 1975-1980 was based on agricultural development in Nigeria 1965-1980 published by FAO which suggests that the Kano River, the Chalawa River and the Hadejia River are large enough for development of several irrigation schemes (MANR, 1975). The report was sub-divided thus: irrigation; drainage and flood control with components as irrigation administered by the government, project description and development. Each phase of the project was to be developed for village and corporate farming. Management of the entire area, the canals, and land clearing was to be directed by the project organisation.

However, background of River Basin Development Authorities (RBDAs) was anchored on Decree Number 25 of 1976 divided the country into eleven (11) river basins, each under the administration of a River Basin Development Authority (RBDAs). These are: the Sokoto–Rima River Basin Development Authority, the Hadejia Jama'are River Basin Development Authority, the Chad Basin Development Authority, the Upper Benue River Basin Development Authority, the Lower Benue River Basin Development Authority, Cross River Basin Development Authority, the Anambra River Basin Development Authority, the River Niger Basin Development Authority, the Ogun-Osun River Basin Development Authority, Benin-Owena River Basin Development Authority and the Niger Delta River Basin Development Authority; (RBDA Decree 87, 1979).

The Hadejia Valley Irrigation Authority (HVIA) was taken over by the Hadejia-Jama'are River Basin Development Authority (HJRBDA) from the MANR, Kano State in 1981. The location of Hadejia Valley Project was maintained as earlier carried out by the MANR, but the original plan of small schemes operated by the ministry was consolidated into two Phases (HJRBDA, 2012). Also, socio-economic and institutional characteristics of farmers in irrigation projects were discussed thus: age, level of formal education, household size, farm size, non-farm income, cost of hired labour, irrigation farming experience, membership of water users' association, reaches, subsidy on inputs, access to credit, and extension visit.

According to Goldface-Irokalibe (2008), for many years the lack of an overall water policy in the form of strategies, functional national water master plans, proper mechanisms for intersectional coordination, tariff setting and conflict resolution has meant that the responsibility for water management for each segment of water use remained diverse and diffused. Different agencies at all tiers of government (federal, state and local government) pursued different water agenda, which made water development policy decision such as abstraction, pollution control, and watershed management highly fragmented. These were discussed as customary law and federal laws.

Like most projects, irrigation has a wide range of beneficial and harmful effects on the environment. The beneficial effects often reflect on the welfare gains by farmers due to increased crop output and the multiplier effect of this on national income and food security. On the other hand, its numerous deleterious effects have been documented as either 'on-site' or 'off-site' effects (WRI, 1992). The following areas were reviewed: impact of irrigation on access to irrigation infrastructure, impact of irrigation on cropped area under irrigation activities, impact of irrigation on crop productivity.

Moreover, **c**entral to the quest for policies and programmes that will reduce poverty is the issue of the conceptualisation of poverty. This was discussed thus: measurement of poverty, causes of poverty, strategies of poverty alleviation with Pre-Structural Adjustment Programme, The Structural Adjustment Programme, Post-Structural Adjustment Programme, 1999-2007 and levels of poverty in the agricultural sector in Nigeria. Addressing the issues of vulnerability has its advantages especially as it relates to poor rural households. For example, Alayande and Alayande (2004) opined that households face different kinds and magnitude of risk that might lead to a wide variation in their income from year to year including loss of productive asset.

However, investment in hydraulic infrastructure, including large dams, is widely advocated as crucial for sustainable economic growth and poverty reduction in many parts of sub-Saharan Africa (World Bank, 2004). But, the cost these structures imposed is much more than financial. Inadequate consideration of both environmental and public health impacts could undermine the benefits to be gained from such investments (McCartney *et al.,* 2007). These were reviewed as environmental, health, physical, crop-related and institutional constraints faced by farmers in irrigation projects

CHAPTER THREE

THEORETICAL FRAMEWORK

The theoretical framework underpinning this study is the Social Change Theory and the Perspectives on Social Impact Assessment.

3.1 The Social Change Theory

Chitamber (1973) defined social change as a change in structure or function of social forms. Besides, Moore (1963) saw social change as significant alteration of social structures (that is, patterns of social actions and interactions) including consequences and manifestations of such structures embodied in norms, values, cultural products and symbols. Change could be planned or unplanned. Planned change involves direct human intervention in directing change towards pre-defined goals, such as, land reforms. On the other hand, unplanned change happens suddenly as accidental change and is usually beyond human control e.g. flood or earthquake (Ekong, 2003). These various explanations on social change could be classified into either theories of causation, of process, or of functional analysis as noted in the works of Chitamber (1973).

However, Giddens (1984) stated that social theory has the task of providing conceptions of the nature of human social activity and of the human agent which could be placed in the service of empirical work. The main concern of social theory is the same as that of the social sciences in general: the illumination of concrete processes of social life. In addition, Archer's (1995),central argument is that "[i]t is only through analysing the processes by which structure and agency shape one another over time that we can account for variable social outcomes at different times." He stated that social change happens in three-part cycles of "(a) structural conditioning, (b) social interaction and (c) structural elaboration".

It was this cyclic nature of social reproduction and transformation that eminently fitted the analysis of irrigation projects. The cyclic nature of water control immediately followed that it was human intervention in the hydrological cycle. Due to the yearly and seasonal climatic cycles of rainfall, sunshine and temperature, the social interaction that water control involved was necessarily cyclic also. One of an endless series of examples of this was the cyclic occurrence of water distribution conflicts in canal irrigation systems. In a study, Mollinga (2003) observed that the original villages were located in the lower parts of the landscape, close to natural water streams, while the newly introduced canals were located in the higher parts of the landscape to permit gravity irrigation. Villages were thus, by design, located in tail-end locations, with agriculture being concentrated in the direct vicinity of the villages.

Similarly, Hadejia Valley Irrigation Project (HVIP) was commissioned in 1992 (Pages, 1995) and covered a developed area of about 6100 ha under surface irrigation. In addition to the barrage on Hadejia River, the irrigation system includes: (1) a complex network of canals of varying sizes and carrying capacity that transport water, in many cases for a considerable distance, from a surface water source (the barrage) to individual fields, and (2) a drainage system to carry away water not used by plants that was as extensive and complex as the supply system. This showed the interplay between technological and institutional or more generally the material and social, structures of water control and how these evolved through socio-technical practices.

Moreover, development interventions were in themselves a legitimisation of a continuous production of discontinuity with the past-from traditional to modern irrigation system. When a situation was chosen for intervention as HVIP, the framework of the intervention was legitimised as a means that could restructure and redefine the existing social practice in a given place. Interventions therefore, always encompassed the promotion of certain normative standards of what development was and entailed (Long and Ploeg, 1989). Consequently, rather than primarily consisting of organisational and material inputs, interventions were constructing images that both diagnosed and determined solutions for 'development problems' (Long and Ploeg, 1989). In addition, large irrigation schemes often created externalities, such as a change in water flows or displacement of indigenous residents (Yahaya, 2002). These externalities were possibly due to the insufficient ex ante assessment conducted prior to the constructions, though positive effects of dams and large-scale irrigation projects have been found in other countries in Africa South of the Sahara (Dillon, 2011).

Consequently, change occured in food and water systems according to prevailing drivers in each and how institutions respond to the drivers. Groups of people might be affected by these changes as they strive to feed themselves and maintain economic activity. In a situation of unequal power, some were likely to be left behind or lose their livelihood support from water and other resources as they were commandeered by others. It was from this theoretical focus on irrigation intervention practice, impact implies outcome of the social change (intervention) programme on the target population, planned at improving the socio-economic status of the target population, their livelihood resulting from benefitting in the programme.

Thus, this theory provided the framework for understanding the social changes that took place in the life of irrigation farmers especially in terms of access to irrigation water between beneficiaries at head, middle and tail-ends of the project, cropped area under irrigation activities, poverty reduction and constraints faced by beneficiaries and non-beneficiaries in the implementation of the project in the study area. In the following section, the sociological perspective useful for clarifyingthe impact of HVIP adopted was presented.

3.2 Social Impact Assessment Perspective

Sanginga *et al.* (1999) opined that impact analysis dealt with the investigation of the changes that occur or likely to occur on peoples' life as a result of a project or programme. They further, stated that Social Impact Assessment (SIA) tries to find out how far the introduction of a technology has been successful in meeting the socio-economic objectives and how well agricultural technologies have satisfied the needs and priorities of households and other units in the target population.

Social impacts include all social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs, and generally cope as members of society. Cultural impacts involve changes to the norms, values, and beliefs of individuals that guide and rationalise their cognition of themselves and their society. While SIA is normally undertaken within the relevant national environmental policy framework, it is not restricted to this, and SIA as a process and methodology has the potential to contribute greatly to the planning process. In general, the SIA process provides direction in (Burdge and Vancla, 1995):

a. Understanding, managing, and controlling change;
b. Predicting probable impacts from change strategies or development projects that are to be implemented;
c. Identifying, developing, and implementing mitigation strategies in order to minimise potential social impacts (that is, identified social impacts that would occur if no mitigation strategies were to be implemented);

d. Developing and implementing monitoring programs to identify unanticipated social impacts that may develop as a result of the social change;
e. Developing and implementing mitigation mechanisms to deal with unexpected impacts as they develop; and finally
f. Evaluating social impacts caused by earlier developments, projects, technological change, specific technology, and government policy.

There are two general approaches to SIA, a generic one and the project level approach (Burdge and Vancla, 1995):

1. The generic approach to SIA sensitises people to general social change,
2. The project level approach to SIA assumes that social change is ubiquitous, but that a new project or policy change alters the normal flow of social change. The researcher or practitioner uses past social science research to better understand what is likely to happen to human populations given different development events,

Morever, Sanginga *et al.* (1999) observed that social impacts manifest on individuals at household, farm or community levels. The indicators of these impacts at household level include among others; income, food security, material possessions, welfare and capital development. Also, at farm level they include; increased crop output, use and allocations of resources, land use expansion and output use. At community level however, it could be seen in the changes of attitudes, values, innovativeness, labour, market expansion, and sustainability of an irrigation system. Therefore, it is assumed that these changes are more likely to happen with than without project. But, it does not mean that the changes always occur from participation rather, it increases the probability that the changes would occur as a result of the participation (Hussain and Hanjra, 2004).

Hence, in this study the theoretical methodology adopted to accomplish the stated objectives was the evaluation of social impacts caused by earlier developments, projects, technological change, specific technology, and government policy as specified by (Burdge and Vancla, 1995). The research strategy was a technique led principally by a core interview schedule (i.e. the leading strategy).

3.3 Conceptualisation of poverty

The conceptualisation of poverty in terms of the risk and vulnerability of those that are poor has emerged at a time when poverty reduction has become an important aspect of the national economic and social policy mix in many developing countries. Indeed, poverty reduction programmes and policies when tied with growth enhancement policies are a high priority in national policy design in countries suffering from increasing population pressures and deteriorating living and economic conditions. Thus, there is an implied consensus in the literature that rapid and sustainable poverty reduction depends upon the interaction of a wide range of policy measures.

Tollens (2002) observed that poverty is not an intrinsic attribute of people, but a product of livelihood systems and the socio–political forces that shape them. Thus, poverty reduction is highly desirable. However, some reduction in rural poverty is sometimes accompanied by increased urban poverty as rural poor choose to move to cities, without finding employment and income there. In contrast, successful rural poverty reduction usually works by raising the productivity of the poor, while most urban poverty alleviation efforts are welfare–oriented.

Moreover, rural poverty alleviation may reduce migration, thus helping to reduce urban poverty. Poverty is multi-dimensional. This suggests that poverty reduction efforts must be multi–targeted and are expected to show wide and diverse dimensions. Solutions to rural poverty have to straddle different disciplines and must encompass economic, social, political and institutional factors. Lifting the rural poor out of their poverty, breaking the poverty circle, through investments in their basic capital stock (physical, human, social) thus appears as sound economic strategy with the added advantage that such economic growth is high quality growth and by definition broad–based and equitable. But, rising out of poverty is no guarantee against falling back into poverty particularly when the centrality of assets for rural poverty reduction is not acknowledged.

International Fund for Agricultural Development (IFAD) (2001) stated that increasing access to assets is crucial for broad–based growth and poverty reduction. Assets take many forms–human and social (education, health, organisations), natural (land, water and forests), technological (farm production, processing and marketing methods), form of livestock and stored commodities). There is strong therefore, complementarity among asset categories. For example, building social capital by strengthening farmers' groups and improving road and communications networks can enhance the financial asset base. Secure land use rights can allow farmers to invest in technology, leading to higher farm productivity and incomes. They may then invest in improved health and nutrition status and their children's education.

Viewed from the foregoing, assistance must focus on the assets of rural poor, enhance them and strengthen them. This includes in particular human assets: better rural health training, and education, but also physical assets: rural infrastructure development, access to markets, improved soil fertility, access to safe water, and increasingly recognised need to reduce heavy biases against rural people, the poor and women in acquiring all forms of assets.

In view of the multi-dimensional nature of the concept of rural poverty, there seems to be no unique framework for analysing poverty reduction programmes. Indeed, poverty reduction is a complex task requiring sustained commitment to consistent, yet flexible, joint action. There are no quick fixes and no easy solutions. No single institution, national or multilateral, public or private, and no single strategy can hope to deal effectively with the different contexts and causes of poverty. Coherent anti-poverty strategy therefore requires stable partnerships, based on trust as well as self-interest.

The World Bank (2000) noted that poverty is an outcome of more than economic process but also include social and political processes that interact with and reinforce each other. In this regard, poverty reduction strategies should be worked out based on each country's economic, socio-political, structural and cultural context. This rests on the argument that such strategies should link the underpinning visions of the economy to societal beliefs and values. In the 1950s, poverty alleviation was not a goal in itself but rather an automatic by-product of economic growth (World Bank, 2000; 2001). However, the event of the late 1960s showed that growth alone was not sufficient to transform the living standard of the poor people in developing countries, as growth could not achieve the purported trickle down effect. This led to a change of focus with emphasis shifting to investment in rural infrastructure and human resources as a means of strengthening the effectiveness of poverty reduction (World Bank, 1990).

Gerster (2000) classified the different poverty alleviation strategies into four, based on their mechanisms. These are:

a) Market based pro-poor growth- a modified version of the orthodox model;
b) Sustainable livelihoods approach- putting people first;
c) Resource based approach focusing on redistribution of assets; and

d) Rights based approach relying on empowerment and redistribution of political power.

Rights and empowerment considers issues like enhancement of political participation, ensuring sound governance, promoting accountability and the rule of law, skill enhancement, vocational training and enhancement of credit availability among others. The Pro-poor growth model is based on the provision of sound macro-economic policy which ensures stability of the economy, conducive business climate, technological innovation which leads to growth of the economy, improved output leading to increased earnings for the people, including the poor.

The redistribution of resources model and sustainable livelihoods approach promote social interaction among groups, provides security against social risks like ill health, economic shocks, natural disasters, provides social and physical infrastructures, such as roads, electricity, water (domestic and irrigation) and social capital. The strategy is often translated into action using such instruments as review of salaries and wages in way that does not cause price instability, removal of gender inequalities and implementation of public works programme to create jobs such as the Hadejia Valley Irrigation Project and institution of safety nets, for those unavoidably caught in the web of deprivation.

3.4 Conceptualising irrigation–poverty linkages

Poverty is an outcome of several complex institutional factors, processes, actions and policies and often affects various households differently, depending upon their entitlements and endowments of natural and human capital resources (Hussain and Hanjra, 2003). The worst kind of poverty is when people do not have access to basic food and water to fulfill their basic physical needs and, therefore, they are undernourished, weak and susceptible to diseases. Another kind of poverty is where people may have more or less enough food but do not have access to other basic needs, such as adequate water for sanitation, health services, clothes and housing. The concept of poverty extends from low levels of incomes and consumption to lack of education and poor health, and includes other social dimensions such as powerlessness, insecurity, vulnerability, isolation, social exclusion, gender and environmental disparities.

Nevertheless, conceptual framework is a construction that shows the relationship existing among variables and most often is shown in a table, graphically or in a regression (Gertler *et al.,* 2010). Given that irrigation water entitlements are generally linked to land, the direct socio-economic benefits of irrigation, in terms of access to irrigation water, crop productivity, farm income, employment opportunities and poverty. This will tend to accrue in form of increased proportion to the size of landholdings, with large holders benefiting more than smallholders and the latter benefiting more than the landless. As with direct benefits, the indirect benefits of irrigation services will also not accrue evenly across various socio-economic groups, due to variations in endowments and entitlements. Poorly managed irrigation generates negative externalities such as land and water degradation, flooding, population displacement, increased incidence of malaria and inequitable distribution of the benefits of public irrigation investments among the rich and the poor. However, these unintended impacts *per se* do not discount the effectiveness of irrigation in alleviating poverty (Hussain and Hanjra, 2003).

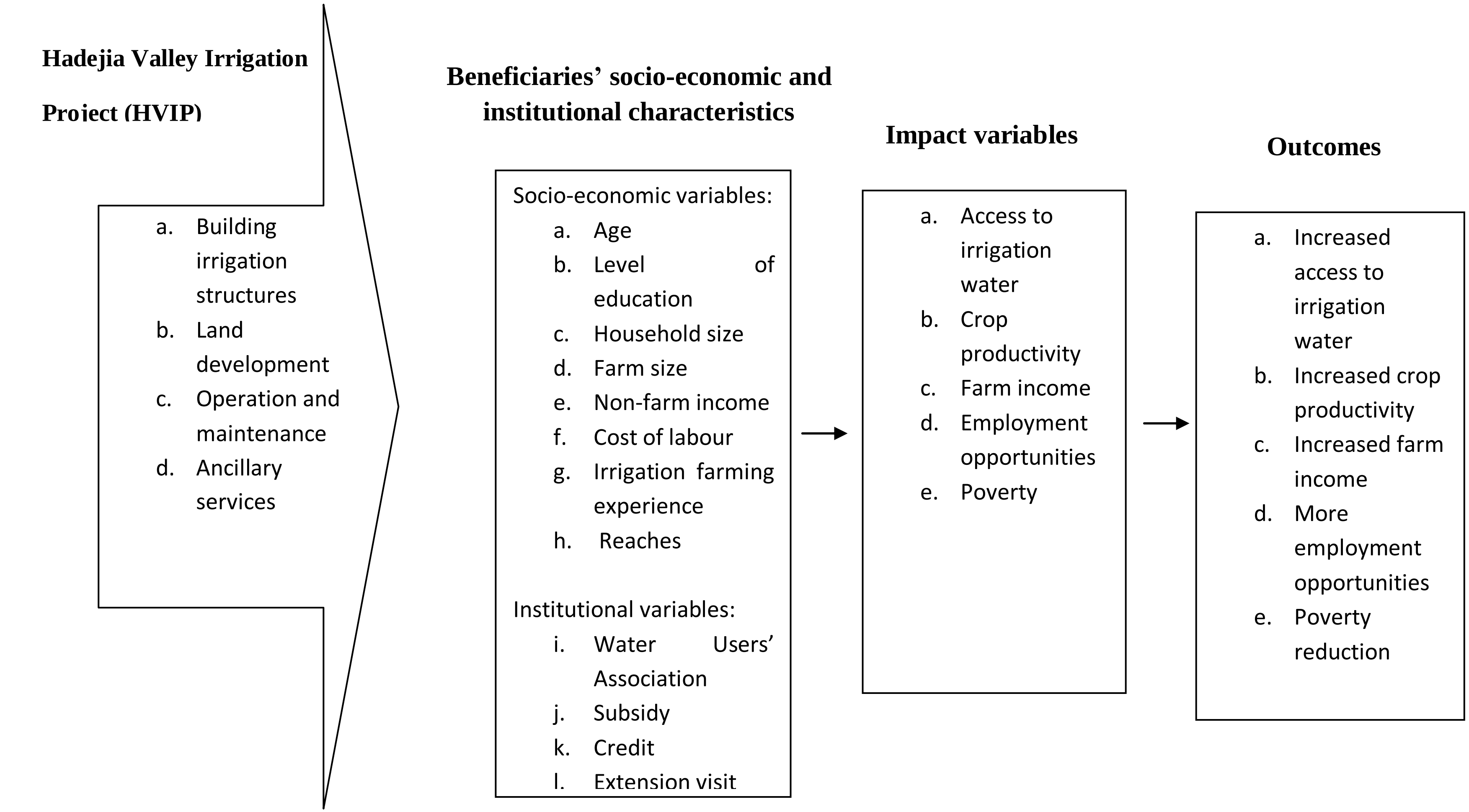

Figure 1: A model of the study

CHAPTER FOUR
METHODOLOGY

4.1 Study Area

The study was conducted in two Local Government Areas (LGAs) of Jigawa State namely: Auyo and Kirikassamma comprising of eight (8) villages each. In Auyo eight (8) villages (the sectors) were: Adaha, Auyo, Ayama, Gamsarka, Ganuwar Kuka, Gatafa, Marina, and Yamidi. In Kirikassamma eight (8) villages (non-project areas) were: Fandum, Ganji, Jiyan, Kubayo, Malinta, Matarar Galadima, Tage, and Turabu. The location of Jigawa State is between 11^0-13^0 N longitude and 8^0 E latitude. The climate of the study area is characterised by relatively wide and rapid changes of temperature and humidity. Humidity at times could rise up to 100 percent in an area considered characteristically dry. The mean daily minimum and maximum temperatures are 15.1^0 and 33.1^0 C, respectively.

The State records a population of 4,361,002,929 (NPC, 2006). The projected population of the state at a growth rate of 3.2 is $1.773479\text{x } 10^{15}$ as at 2014. The Local Government Area of Auyo has a population of 132,001 and Kirikassamma has 191, 523 persons (NPC, 2006). The projected population of Auyo is $5.368102 \text{ x } 10^{10}$ and that of Kirikasamma is $7.788692 \text{ x } 10^{10}$ as at 2014 respectively. The state covers a landmass of about 22,410 Sq/km and the bulk of agricultural production is undertaken by small-scale farmers using family labour, capital and management. Major crops grown are: millet, sorghum, rice, wheat, cowpea, groundnut, maize, sesame, vegetables and cotton. Livestock such as cattle, sheep, goat and poultry are also raised. The cropping pattern is mixed cropping with few farmers practicing sole cropping. The major crop mixtures are millet/sorghum, millet/cowpea or millet/groundnut. Agriculture in the state as in other peasant settings is characterised by low levels of production which as a result of the use of manual tools, inadequate credit facility, high level of risks (drought, flood, pests and diseases) and illiteracy.

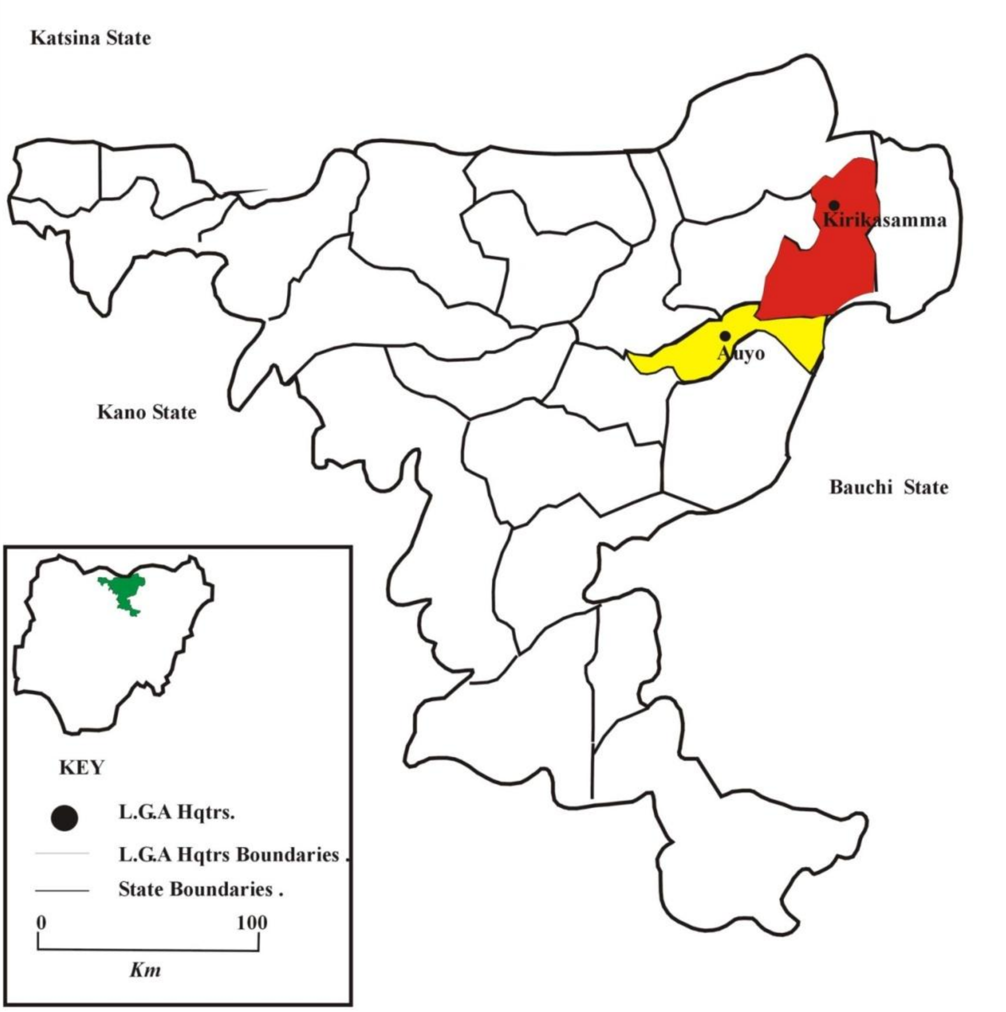

Figure 2: Map showing the study area

4.2 Sampling Procedure and Sample Size

Hadejia Valley Irrigation Project (HVIP) is under Hadejia-Jama'are River Basin Development Authority (HJRBDA) owned by the Federal Government of Nigeria, which used a barrage at Gamsarka to provide irrigation water to the sector areas. Private irrigation schemes (where farmers use tube wells) in the non-sector areas were used as a control for the study. At the chosen research location of Jigawa State, the Hadejia emirate has eight Local Government Areas (LGAs)—Auyo, Birniwa, Hadejia, Kaffin-Hausa, Mallam Madori, Kaugama, Kirikasama, and Guri. Auyo and Kirikasama LGAs were selected for the field study, which represent the first stratum.

These were specifically chosen because while Auyo LGA has the HVIP developed irrigable areas (known as the “sectors”), Kirikasama LGA has 80 percent of dry-season irrigation activities in the Hadejia emirate as pointed out by Omilola (2009). The second stratum of the sampling technique took place at the village level. A quick tour of all the villages in Auyo and Kirikasama LGAs was made in order to obtain a general picture of the prevailing situation with regards to the use of irrigation technologies.

Sixteen villages were selected for the study, and eight were from Auyo LGA comprising Adaha, Auyo, Ayama, Gamsarka, Ganuwar Kuka, Gatafa, Marina and Yamidi. Similarly,eight private farms located in Kirikassama LGA (along the tributaries of rivers Hadejia and Kafin-Hausa) consisted of Fandum, Ganji, Jiyan, Kubayo, Malinta, Matarar Galadima, Tage and Turabu were selected as non-project area (non-sectors). The sixteen villages were purposively selected to ensure that they were representative of other villages in the same general location.

The third phase of the field work component was the main survey in which in-depth collection of data took place in 2014. In this study, proportionate random sampling of beneficiaries (207) and non-beneficiaries (146) was conducted because of the multi-stage random sampling approach adopted, which requires larger samples than single-stage design. Three hundred and fifty-three (353) beneficiaries and non-beneficiaries were interviewed as the sample sizes of the study.

Table 4.1: Population and sample sizes of Beneficiaries and Non-beneficiaries (n = 353).

	Beneficiaries		Non-beneficiaries		
Villages	**Sampling frame**	**Sample size (5%)**	**Villages**	**Sampling frame**	**Sample size (5%)**
Adaha	534	27	Fandum	250	13
Ayama	468	23	Ganji	320	16
Auyo	520	26	Jiyan	500	25
Gamsarka	543	27	Kubayo	180	9
Ganuwa	452	23	Malinta	260	13
Kuka			Matara	300	15
Marina	432	22	Galadima		
Yamidi	437	22	Tage	400	20
Zumoni	740	37	Turabu	700	25
Total	**4126**	**207**		**2910**	**146**

Source: Reconnaissance Survey (2014)

4.3 Data Collection and Sources

The study used both primary and secondary data sources. The primary data were obtained using a structured questionnaire administered to the beneficiaries and non-beneficiaries in the Project and Non-project areas. Demographic and socio-economic information as well as information on access to irrigation water, cropped area under irrigation activities, crop productivity, farm income, and employment opportunitieswere collected. P-alpha poverty measure (Foster-Greer-Thorbecke Index) method was used for the measurement of poverty among beneficiaries and non-beneficiaries while the Tobit regression model, a hybrid of the discrete and continuous dependent variable was used to estimate the determinants of poverty among the respondents.

Also, respondents were asked constraints they faced in the implementation of the Project’s activities for instance, areas that dealt with (irrigators' contact with conflicting interests on soil erosion, water logging, project activities, irrigation pump operation, diseases and weeds, cost of inputs, subsidies, credit, infrastructure, market price of farm produce, quela birds, and disease control measures).

4.4 Analytical Framework

The procedure for analysing the data generated was the use of statistical package called Statistical Programs for Social Scientists (SPSS) and STATA software. The following tools of analysis were employed to achieve the stated objectives of the study: descriptive statistics, t-test statistic, F test and P-alpha poverty measure (Foster-Greer-Thorbecke Index) method was used for the measurement of poverty among beneficiaries and non-beneficiaries of the Project. Tobit regression model, a hybrid of the discrete and continuous dependent variable was used to estimate the determinants of poverty among the respondents.

4.4.3 Descriptive statistics

The descriptive statistics employed in this study include the use of means, percentages, graphs, standard deviation and frequency count were used to summarise, classify and tabulate data on Beneficiaries' and Non-beneficiaries' socio-economic characteristics and other variables in the study. They were used to achieve objectives 1, 2, 3, 6 and some parts of 4 and 5.

4.4.2 Paired t-test

The paired t-test compared the paired groups. It calculates the differences between each set of pairs, and analyses the list of differences based on the assumption that the differences in the entire population followed a Gaussian distribution (Graph, 1999). The paired t-test is used when measurements are taken from the same subject before and after some manipulations are done. It is used to compare samples that are subjected to different conditions, provided the samples in each pair are identical (David, 2005).

To further, achieve objectives 2, 3 and parts of 4 and 5 a paired t-test was used to measure the impact of the project, which compared the differences in access to irrigation water and irrigation cropped area, poverty reduction between the beneficiaries and non-beneficiaries of the project. It was also, used to test the hypotheses to determine the impact of the project. According to Weistein (2006) the test could be applied as specified in equation:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{X_1X_2} \cdot \sqrt{\frac{1}{n}}}$$

Where;

$$s_{X_1X_2} = \sqrt{(s_{X_1}^2 + s_{X_2}^2)}$$

t = the calculated t-test value,

$\dot{X}_1$= mean value of beneficiaries,

$\dot{X}_2$= mean value of non-beneficiaries,

$s_{X_1X_2}$ is the grand standard deviation (or pooled standard deviation), 1 = group one, 2 = group two.

$s_{X_1}^2$ and $s_{X_2}^2$ are the unbiased estimators of the variances of the two samples(beneficiaries and non-beneficiaries),

The denominator of *t* is the standard error of the difference between two means.

t = significant at 5% (two-tailed test) = 1.96.

4.4.3. Analysis of variance (ANOVA)

To achieve objective 4 this technique was used. ANOVA compares mean values through a process that involves separating the total variance of a dataset into distinct components, typically the variance within distinct groups (sometimes referred to as the *within-group* variance or *error variance*) which is treated as *unexplained*, and the *between-group* variance, which is a function of the size of the differences in the mean values of the various groups, and is treated as *explained* by underlying differences between the groups. The most basic linear model is of the form (de Smith, 2012):

$$Y_{ij} = \mu + T_j + e_{ij}$$

This states that the observed or measured value *y* (observation *j* in group *i*) is a linear combination of an overall mean value, μ, plus a treatment or group effect, *T*, plus some unexplained random variation, or *error*, *e*. It is assumed that the error component has a mean value of 0, a common variance across groups.

4.4.4 Foster-Greer-Thorbecke index method

Further, to achieve objective 4 the mathematical model developed by Foster-Greer-Thorbecke (1984), which is also called the P-alpha class of poverty measures was used. The model is specified thus;

$$P_\alpha = \frac{q}{N} \sum_{i=1}^{q} \left(\frac{Z_i - Y_i}{Z}\right)^{\alpha} \quad \ldots\ldots (1)$$

Z = Poverty line, q = number of households below the poverty line, N = number of households in the reference population, Y_i = Average expenditures of respondents households, α = Foster-Greer-Thorbecke (FGT) index which takes the values of 0, 1, 2. In using this model, consideration was given to the differences in the needs of the respondents due to the different household size and consumption. The household expenditure per adult equivalent was used as the welfare measure. There are wide choices of adult equivalent scales and different scales are used in different countries. The most commonly used is that of Organisation for Economic Cooperation and Development (OECD) because of its simplicity of use and wide familiarity. The scale is expressed as:

$$\text{Expenditure} = \text{Exp}/n^{0.7}$$

Exp = Total household expenditure

n = Household size

0.7 = exponential formation representing other adults in a particular household

A cut-off point needs to be selected to serve as a poverty line across the distribution of the household expenditure per adult equivalent. The use of an absolute line such as X dollars in Purchasing Power Parity (PPP) is rejected due to frequent fluctuations in the country's exchange rate, hence a relative poverty line set at one-third (1/3) of the mean consumption-expenditure would be used in identifying the core poor (Anyanwu, 1997).

Components and derivations of the FGT model are:

1. **Simple Head Count Ratio (HCR**). This gives the percentage of the sample living in the household with expenditure per capita less than the poverty line. In other words, it measures the number of poor as a percentage of the total population. The poverty aversion parameter equals 0 from equation (1), if $\alpha = 0$, the poverty index becomes;

   $P = q/N$………………………………………………………………. 2

2. **Poverty Depth (PD).** The Poverty Depth or Expenditure Gap Ratio expresses the average shortfall of expenditure as a fraction of the poverty line itself. It can be used to determine the percentage of the expenditure required to bring each individual below the poverty line up to the poverty line. A useful index is obtained when the HCR is multiplied by the income or expenditure gap ratio or it is used when the poverty aversion parameter is equal to 1 (Foster *et al.*, 1984);

   $$P_1 = \frac{q}{N} \sum_{i=1} \left(\frac{Z-Y_i}{Z}\right)^1 = HI \quad \text{………………..…..……………………………… (3)}$$

3. **Poverty Severity Index (PS)**. This is the mean of the squared proportion of the poverty gap expressed as;

   $$P_2 = \frac{q}{N} \sum_{i=1} \left(\frac{Z-Y_I}{Z}\right)^2 = \quad \text{…………………..…..……………………………… (4)}$$

This index attaches greater weight to the poverty of the poorest people than to those just below the poverty line.

4.5 Operational Definitions and Measurement of the Study Variables

The operational definitions and measurement of the study variables were:

A. Independent variables

4.6.1 **Age** This was defined as the number of years of a respondent from the date of birth to the time of the study. It was measured by scoring the number of years given by the respondent.

4.6.2 **Level of education** This was the ability of an individual to read and write in a formal or informal organised means or through schooling. Respondents were asked the number of years spent in formal education which constituted the score.

4.6.3 **Household size** This referred to the total number of individuals in the household which included: wives, children, relatives, and dependents that resided within the same household and eat from "the same pot". It was measured in total number of persons in the respondents' household.

4.6.4 **Farm size** This meant the total amount of land put under cultivation using irrigation water in the Project and Non-project areas. It was measured in hectares.

4.6.5 **Non-farm income** This referred to the income derived from off-farm activities. It was measured by scoring the reported amount in naira (₦).

4.6.6 **Cost of hired labour** This meant the use of hired labourers on the farm by the respondents. It was measured as the amount of naira (₦) spent by the respondents acquiring labour for their farms in 2014 season.

4.6.7 **Irrigation farming experience** This referred to the actual number of years spent by the respondent using irrigation method on the farm. It was measured as the number of years reported by the respondents.

4.6.8 **Membership of water users' association (WUA)** This meant an individual belonging to a Water User Association (usually on part-time and without pay). This was measured as whether the respondent registered or not. Therefore, 1 registered and; 0 non-registered.

4.6.9 **Reaches** This meant the distance of the farm from the source of water (dam or tube well). It was measured in kilometers reported by the respondents.

4.6.10 **Subsidy on inputs** This referred to either money or inputs such as seeds, fertilizer, chemicals, tractor hiring services etc, provided at reduced price to the farmers by the Project. It was measured by assigning 1 for receiving subsidy; and 0 for not receiving subsidy by the farmers.

4.6.11 **Access to credit** This meant the access to capital in the form ofloans necessary for financing the production process. It was measured by scoring the total amount of cash in naira (₦), and the value of fertilizer, seeds and chemicals collected as loans in the 2014 season from the Project, Banks, ADP, Moneylenders and /or Relatives/Friends.

4.6.12 **Extension visit** This referred to the number of visits received by the farmers in the season (2014) by the extension agents of the Project or ADP. It was measured by scoring the reported total number of visits by extension agents to the respondents in 2014 season.

B. **Impact variables**

4.6.13 **Access to irrigation water** This referred to timely supply of water from the dam for irrigating the crops by the farmers. It was measured by asking and scoring the opinion of beneficiaries 1 for agree and 0 for disagree on the following irrigation service parameters: water availability, equity in distribution, satisfaction and payment of water charges. The project area was divided into:

a) **Head reach-** farms that were situated from the barrage to the first sluice gate which was 9 kilometers wide (from the barrage to Auyo village),

b) **Middle reach-** farms that were situated from the first sluice gate to the second gate which was 6 kilometers wide (from Auyo to Gatafa village),

c) **Tail-end-** farms that were situated from the second sluice gate to the last reservoir which was 3 kilometers wide (from Gatafa to Yamidi village).

4.6.14 **Crop productivity** This referred to the index of the ratio of the value of total farm output to the value of the total inputs used in the production in 2014. Major crops grown by farmers like maize, rice, wheat, pepper, tomato, okro, onion, water melon, and amaranthus were measured in kilogrammes. The total yield for the number of crops grown by a respondent was scored as the output divided by the farm size.

4.6.15 **Farm income** This meant the total returns from the sales of irrigated crops less the total cost of production. It was measured in naira (₦) based on the prevailing market price obtained by the respondents at the time of the study.

4.6.16 **Employment opportunities** This meant the number of jobs available for pay. It provides the number of work opportunities in which people engaged to earn a living. Thus, this factor was measured by the total number of jobs engaged and mentioned by the respondents in the study area.

4.6.17 **Poverty** This is defined as a level of total earnings that is insufficient to obtain the minimum necessities of life (including food, house rent, and other basic needs) and for the maintenance of physical efficiency. It was measured using a) the Head Count Index, b) Poverty Gap Ratio, and c) Poverty Severity Index.

4.6 Empirical Model for the Determinants of Household Poverty Status

To achieve objective 5 this model was used. According to Joreskog (2002), a censored variable has a large fraction of observations at the minimum or maximum. Because the censored variable is not observed over its entire range ordinary estimates of the mean and variance of a censored variable will be biased. Ordinary least square (OLS) estimates of its regression on a set of explanatory variables will also be biased. These estimates are not consistent, i.e., the bias does not become smaller when the sample size increases. The maximum likelihood estimates are consistent, i.e., the bias is small in large samples.

Censored regression models commonly arise in econometrics in cases where the variable of interest is only observable under certain conditions. Censored regression models refer to model in which one observes the dependent variable only if it is above or below some cut off level. The first example of censored regression appears to be that of Tobin (1958). According to Wooldridge (2002) in censored regression applications, there is a variable with quantitative meaning, y^* and one is interested in the population regression $E(y^*)$. If y^* were observed for everyone in the population, one could use OLS etc. However, a data problem arises in that y^* is censored from above and/or below i.e. it is not observed for some part of the population. The Tobit model is a special case of a censored regression model, because the latent variable cannot always be observed while the independent variable x_i is observable.

In order to estimate the determinants of household poverty in this study, a Tobit regression model was conceptualised. The full model, which was developed by Tobin (1958) is expressed in equation 5 following McDonald and Moffit (1980). The Tobit model originates from the work of Tobin (1958) and has been extensively used by economist to measure the effect of changes in the explanatory variables (x_i) on the probability of being poor and the depth or intensity of poverty (McDonald and Moffit, 1980). The Tobit model can be used to determine the impact of the explanatory variables on the probability of being poor. The model assumes that many variables have a lower (or upper) limit and take on this limiting value for a substantial number of respondents. For the remaining respondent, the variables take on a wide range of values above (or below) the limit. The model measures not only probability that a farmer is poor but also the intensity of poverty (Tobin, 1958).The model is expressed based on Tobin (1958):

$Y_i = Y^* = Xi\beta + Xn\beta n + ei$……………………………………………………….(5)

Where,

Y = Expenditure (₦)

X_1 = Age (Number of years)

X_2 = Level of education (Number of years)

X_3 = Household size (Total number of persons)

X_4 = Farm size (Hectares)

X_5 = Non-farm income (₦)

X_6 = Cost of hired labour (₦)

X_7 = Irrigation farming experience (Number of years)

X_8 = Membership of water users' association (WUA) (1 registered and; 0 non-registered)

X_9 = Reaches (kilometers)

X_{10} = Subsidy on inputs (1 for receiving and 0 for not receiving subsidy)

X_{11} = Access to credit (₦)

X_{12} = Extension visit (Number of visits)

β is a vector of unknown coefficients and

e_i is an independently distributed error term.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1 Socio-Economic and Institutional Characteristics of Beneficiaries and Non-beneficiaries

The first objective of the study was to describe the socio-economic and institutional characteristics of the respondents. These were: age, level of formal education, household size, farm size, non-farm income, cost of hired labour, irrigation farming experience, membership of water users' association, reaches, subsidy on inputs, access to credit, and extension visit. The results are presented in Tabe 5.1.

Age distribution

Table 5.1 shows that the age distribution of the respondents was between a mean of 47 and 45 years. In a similar study, Mohammed *et al.* (2009) studying the Upper Benue River Development Authority (UBRBDA) showed that the minimum, maximum and mean ages of the respondents were 40.00, 69.00 and 59.84 years respectively. This meant that both were within the agricultural productive age range of 30–55 years quoted by Food and Agriculture Organisation (FAO, 1992).

Household size

The study examined the household size distribution of the respondents. As shown in Table 5.1 the households have a mean of 15 and 21 in which project beneficiaries had higher mean household size than non-beneficiaries. Larger family sizes might play a significant role in provision of family farm-labour which helps to reduce expenditure on production, but increased costs of expenses on the family. The larger sizes of families discovered in this study could go a long way in assisting the high-aged respondents to continue operating (Murtala *et al.,* 2004).

Formal education

Mean difference in the educational levels of respondents interviewed in the sixteen survey villages were 8 and 7 for beneficiaries and non-beneficiaries respectively. Most studies dealing with agricultural production argued that schooling or the level of education of a farmer helps the farmer in the use of production information leading to increased yield. Pudasaini (1983) documented that education contributed to agricultural production in Nepal via the farmers' knowledge and allocated effects.

Non-farm income

Results from this study pointed out that respondents received a wide range of off-farm income that ranged from a mean of ₦ 137, 797=00 and ₦ 237, 104 = 00 Naira between beneficiaries and non-beneficiaries in that order. This supported the report that as much as 60 percent of an average Nigerian farm household's cash incomes were derived from non-farm activities with an average of 36 percent adult working hours devoted to non-farm activities (DFID, 2004).

Irrigation farming experience

The results in Table 5.1 revealed a mean of 30 and 24 years of irrigation farming experience for both project and non-project beneficiaries. But, these results were higher than 10.8 years found by Umoh (2006) and Idiong *et al.* (2006) among rice farmers in Cross Rivers State of Nigeria.

Farm size

The results indicated that beneficiaries have farms with a mean of 3.2 hectares whereas non-beneficiaries have farms with a mean of 2.1 hectares (Table 5.1). A study by

Ogundele and Oruruwa (2004) showed that farm size significantly determines levels of technical efficiency in Nigeria.

Cost of hired labour

Table 5.1 show that a mean of ₦ 33,641=00 and ₦ 55, 709 = 00 Naira were spent in hiring labour by both project and non-project beneficiaries. This confirmed the findings of Adegeye and Dittoh (1985) who observed that in Nigeria although three types of labour could be distinguished that is, family, hired and exchange labour, family labour is the major source. They further, pointed out that family labour is predominantly used in Nigeria and it comprises the labour of all males, females and children in the family or household because they participated in the cultivation of the household activities.

Reaches

Results of this study show that project beneficiaries have farms with a mean of 3 kilometers away from water source (Dam) while non-project beneficiaries have farms located 0.9 kilometer from water source perhaps, river Hadejia (Table 5.1). Similarly, Jelili *et al.* (2011) observed that farmers in the low intensity group cultivated farmland that were farther away from their residence (5.75km) than farmers in the medium (2.92km), high (4.89km) and very high (3.62) intensity categories.

Extension visit

The findings in Table 5.1demonstrate that project beneficiaries received a mean of 5 extension visits between while non-project beneficiaries received a mean of 3 visits in a season. Agricultural extension represents a mechanism by which information on new technologies, better farming practices and management could be transmitted to farmers. Also, Owen *et al.* (2001) investigated the impact of farmers' contact with agricultural extension services on farm productivity and the results showed that access to agricultural extension services, defined as receiving one or two visits per agricultural year, raised the value of crop production by about 15 percent.

Access to credit

A mean of ₦ 52, 771= 00 and ₦50, 205 = 00 Naira were received as credit by project and non-project beneficiaries respectively. Credit plays an important role in increasing agricultural productivity. Timely availability of credit enables farmers to purchase the required inputs and machinery for carrying out farm operations (Saboor *et al.,* 2009).

Access to subsidy on farm inputs

The results of the study pointed out that a mean of ₦ 50, 205 = 68 and ₦ 32, 422 = 33 Naira were received by both project and non-project beneficiaries as subsidies on farm inputs in that order. As Dorward *et al.* (2004), argued that sustained (but not indefinite) input subsidies were a major part of successful Green Revolution packages making a critical contribution to thickening and thus 'kick starting markets' first within staple food supply chains and then in the wider rural economy. They identified these as potentially the major pro-poor growth outcomes of a long-term consistent input subsidy programme in Malawi (Dorward *et al.,* 2007).

Membership of water users' association

Results of membership of cooperative societies indicated mean of 0.8 and 0.5 number of membership of the project and non-project beneficiaries belonging to the social organisation registered under the scheme (Water Users' Association and Fadama Users' Associations for the non-project area). However, attempts to establish WUAs elsewhere – such as at KRIP (HJRBDA), Wurno (Sokoto State), LAIP (AIRBDA) and Bakolori (SRRBDA) – brought little success: they have either dissolved or live on without performing any useful function. The non-effectiveness of the WUAs could be attributed to the constraints faced by the RBDAs and as such there were no incentives for WUAs to succeed (Enplan Group, 2004).

Table 5.1: Distribution of beneficiaries and non-beneficiaries by socio-economic and institutional characteristics

Variables	Respondents' type	N	Mean	SD	Min.	Max
Age	Beneficiaries	207	47	9.4	18	75
	Non-beneficiaries	146	45	11	27	72
Household size	Beneficiaries	207	21	11	0	18
	Non-beneficiaries	146	15	9	0	52
Level of education	Beneficiaries	207	8	7	0	15
	Non-beneficiaries	146	7	7	0	25
Non-farm income	Beneficiaries	207	137,797	222, 554	1500	1500000
	Non-beneficiaries	146	237,104	298,047	10000	2000000
Irrigation farming	Beneficiaries	207	30	13	2	60
Experience	Non-beneficiaries	146	24	11	0	50
Farm size	Beneficiaries	207	3.2	8	1	12
	Non-beneficiaries	146	2.1	2	0.5	7
Cost of hired labour	Beneficiaries	207	33,641	25,408	10000	280000
	Non-beneficiaries	146	55,709	58,460	0	400000
Reaches	Beneficiaries	207	3	2	0	2.4
	Non-beneficiaries	146	0.9	0.2	0	2
Extension visit	Beneficiaries	207	5	3	1	20
	Non-beneficiaries	146	3	0.912	1	4
Credit	Beneficiaries	207	52,771	81,646	0	500000
	Non-beneficiaries	146	50,205.68	51325.79	0	400000
Subsidy on inputs	Beneficiaries	207	32,422.33	35138.21	0	500000
	Non-beneficiaries	146	11,917.81	17850.92	0	800000
Water/Fadama Users'	Beneficiaries	207	0.845	0.363	0	1
Association	Non-beneficiaries	146	0.52	0.501	0	1

Source: Reconnaissance Survey, 2014.

5.2 Impact of the Project on Access to Irrigation Water

Objective two of the study was to analyse the impact of the project on access to irrigation water between beneficiaries at head, middle and tail-ends of the project. The results of this study in Table 5.2 show that 48%, 30% and 22% of beneficiaries were located at head, middle and tail reaches of the project area respectively. This might not be unconnected to the slow construction work of the project since it was planned to cover 25,000 hectares whereas only 6100 hectares have been so far developed. For many people access to natural resources is the basis for sustainable livelihoods. Especially, rural households depend on access to and availability of fertile land, grazing grounds, water, woods and fish grounds. Farmers use water to irrigate their fields, to cultivate their crops, for domestic use or sale. Thus, access to water contributes to the benefits of the farmer. In their study, Latif *et al.* (2009) proved that farmer's location on the irrigation network has significant impact on their income in spite of the fact that water rights were the same for all water users.

Moreover, in the past, analysis of irrigation service delivery has been undertaken at different points of time on different systems, following different methodologies. Opinion surveys have been used to quantify the opinion of the people (Mohammed *et al.*, 2009). Mohammed *et al.*(2009) further pointed that the quality of irrigation services include components like availability of distribution, equity, level of satisfaction of irrigation water supply, payment of water charges, adequate water supply to the entire command, timeliness of water supply, equitable supply across the command, accountability or the responsiveness of the staff towards the farmers and timely repair and maintenance of the irrigation infrastructure. Thus, this study tried to quantify the opinion of the beneficiaries on each of the components of irrigation service with regards to availability of distribution, equity, level of satisfaction of irrigation water supply and payment of water charges. It then condensed this information in a format that could be used to easily map access of irrigation water in a canal system of Hadejia Valley Irrigation Project.

However, the results of a paired t-test on irrigation service parameters to determine access to irrigation water showed that the t-calculated on: irrigation water availability; t

= 1.571, 1.518, and 1.448; p = 0.399, 0.319 and 0.437, equality of water distribution: t = 1.554 1.513 1.554, p = 0.4, 0.319 and 0.428; satisfaction with water distribution: t = 1.426 1.364, and 1.431, p = 0.408, 0.338 and 0.438) were less than the t critical (1.96) at 0.05% whereas on water charges t = 2.193, 1.909 and 2.233 between head and tail-end were greater while at the middle was less than the t critical (1.96) at 0.05% at level of significance.

Table 5.2: Distribution of benefiiciaries according to farm location (n= 353).

Location	Beneficiaries Freq	Percent (%)
Head-reach	99	48
Middle-reach	63	30
Tail-end	45	22
Total	**207**	**100**

Source: Reconnaisance Survey, 2014.

Table 5.3 : Distribution of beneficiaries according to access to irrigation water (n=207).

Parameter	Head-reach	Middle-reach	Tail-end
Water availability			
Available	86 (87)	62(98)	45(100)
Not available	13 (13)	1(2)	0(0)
Equality			
Equal	89(90)	60(95)	0(00
Fairly equal	10(10)	3(5)	40(89)
Not equal	0(0)	0(0)	5(11)
Satisfaction			
Yes	69(70)	28(60)	0(0)
No	30(30)	27(40)	45(100)
Water charges			
Beginning	25(25)	23(37)	11(24)
Middle	7(7)	10(16)	0(0)
End	67(68)	30(48)	34(76)

Source: Reconnaissance Survey (2014)

Figures in parentaces are percentages

Table 5.4: Results of t-test on access to irrigation water by beneficiaries (n=207).

Parameters	Mean	SD	t-value	p-value	Std Error Difference
Water availability:					
Head	8.1	23.053	1.571	0.399	5.155
Middle	7.2	21.217	1.518	0.319	4.744
Tail	5.4	16.681	1.448	0.437	3.73
Equality of distribution:					
Head	8.1	23.303	1.554	0.400	5.211
Middle	7.2	21.827	1.513	0.319	4.76
Tail	5.4	15.645	1.554	0.428	3.498
Satisfaction on distribution:					
Head	8.1	25.404	1.426	0.408	5.68
Middle	7.2	23.612	1.364	0.338	5.28
Tail	5.4	16.875	1.431	0.438	3.773
Water charges:					
Head	8.1	16.827	2.153	0.371	3.763
Middle	7.2	16.864	1.909	0.276	3.771
Tail	5.4	10.816	2.233	0.403	2.419

5.3 Impact of the Project on Cropped area Under Irrigation Activities

Objective three of the study was to evaluate the impact of the project on cropped area under irrigation activities of beneficiaries and non-beneficiaries in the study area. The results in Table 5.1 on page 75 suggest that beneficiaries have a mean farm size of 3.2 hectares in the project area. On the other hand, non-beneficiaries have a mean farm size of 2.1 hectares.This is in congruance with findings of the International Fund for Agricultural Development (IFAD) (2010) reported that about 90% of Nigeria's food is produced by smallholder farmers who cultivate small plots of land, usually less than 1 hectare of land per household.

Moreover, maize (24%) and rice (76%) were the dominant crops grown by the project beneficiaries whereas apart from maize (43%) and rice (48%), non-beneficiaries cultivated other crops in the following order: onion and tomato (0.3% each) wheat (4%), other crops (5%). The implications of these findings are that while project beneficiaries were moving towards specialisation, non-beneficiaries diversified their crop production activities (Table 5.5). Within the project command area, cropped area devoted by beneficiaries were maize (36%), rice (64%) at head, maize (11%), rice (88%) in the middle reaches, and maize (10%) rice (90%) at tail reaches of the project area.

Table 5.5: Distribution of beneficiaries and non-beneficiaries according to cropped area (n=353).

Crops	**Beneficiaries**		**Non-beneficiaries**	
	Cropped area (Has)	**Percent(%)**	**Cropped area (Has)**	**Percent(%)**
Maize	156	24	132	43
Rice	502	76	146	48
Wheat	0	0	11	4
Onion	0	0	0.9	0.3
Tomato	0	0	1	0.3
Pepper	0	0	0	0
Others	0	0	15	5
Total	**658**	**100**	**306**	**100**

Source: Reconnaisance Survey, 2014.

Table 5.6: Distribution of beneficiaries according to cropped area (n=207).

Crops	**Cropped area (Has)** 120	**Head-reach** **Percent (%)**	**Middle-reach** **Cropped area (Has)**	**Percent(%)**	**Tail-end** **Cropped area (Has)**	**Percent (%)**
Maize	215	36	22	11	12	10
Rice	335	64	173	88	114	90
Total		100	195	99	126	100

Results of a paired *t*-test assuming equal variances using a pooled estimate of the variance was performed to test the resulting mean cropped area under irrigation activities of beneficiaries and non-beneficiaries. Table 5.7 shows that the mean irrigation cropped area of beneficiaries of 50.74 and that of non-beneficiaries of (34) and t (18) = 1.817, p = 0.043 was less than t critical (1.96) at 0.05% level of significance. Also, the mean irrigation cropped area of beneficiaries between head 27.89, t (18) = 1.868, p = 0.039; middle 24.26, t (18) = 1.794, p = 0.045, and tail-end 16.89, at, t (18) = 1.6, p = 0.064 were less than t critical (1.96) at 0.05% level of significance.

Table 5.7: Results of t-test on cropped area of beneficiaries and non-beneficiaries (n=207).

Category	Mean	SD	t-value	p-value	Std Error Difference
Beneficiaries	50.74	121.682	1.817	0.043	27.916
Non-beneficiaries	34	59.879			
Head	27.89	65.087	1.868	0.039	14.932
Middle	24.26	58.963	1.794	0.045	13.527
Tail	16.89	54.376	1.6	0.064	10.559

5.5 **Impact of Hadejia Valley Irrigation Project on Poverty Status**

Objective four of this study was to assess the Impact of Hadejia Valley Irrigation Project on poverty status of beneficiaries and non-beneficiaries. The results are discussed as:

5.4.1 Impact on employment opportunities

The findings of this study revealed that there were a wide range and diverse employment opportunities created as a result of Hadejia Valley Irrigation Project in the communities studied. The results in Table 5.8 on page 82 showed that 23% of the respondents opined that fishing was another opportunity created by the project in the area. Also, 22% of the respondents reported trading as additional income earning activity which has been brought to the area as a result of the project. Moreover, 18% reported commercial transportation and 16% stated bricklaying, Hunting was affirmed by 8% of the beneficiaries while 4% each reported working as hired labourers and animal traction by the beneficiaries. And 2% each of the beneficiaries averred water vending and equipment repairs as additional income earning activities in the area.

On the other hand, 2% of the non-beneficiaries engaged in repairs of pump machines while 5% reported hired labour and trading as additional income earning activity which had brought additional income to them. Moreover, 17% of the non-beneficiaries stated commercial transportation, bricklaying, and animal traction. Fishing was affirmed by 32%. As such this finding indicated that now the people have diverse pathways by which they can enhance their living condition consequently, these complementary activities (employment opportunities) have great potentials to contribute to the current fight against poverty in Jigawa state in particular and Nigeria at large. This study supported the development paradigm where the proponents of the theory pointed out that, agricultural development projects bring about total transformation in the quality of life of the people through providing the required resources and job opportunities (World Bank, 2001).

The mean employment opportunities of beneficiaries (M = 17.35, SD = 16.83, N = 19), t (18) = 4.583, p = 0.000, was less than t critical (1.96) at 0.05% level of significance.

Table 5.8: Distribution of beneficiaries and non-beneficiaries according to employment opportunities (n=353).

Employment	**Beneficiaries**		**Non-beneficiaries**	
	Freq	**Percent (%)**	**Freq**	**Percent (%)**
Bricklaying	32	16	25	17
Draught animal	8	4	25	17
Equipment repairs	5	2	3	2
Fishing	48	23	46	32
Hired farm labour	9	4	8	5
Hunting	16	8	0	0
Transportation	38	18	25	17
Trading	46	22	8	5
Water vendor	5	3	0	0

Source: Reconnaissance Survey, 2014.

5.4.2 Impact on irrigated crop productivity

According to this study, the overall evidence suggested that carefully designed irrigation dams could significantly improve agricultural production and overall food security. This referred to the index of the ratio of the value of total farm output to the value of the total inputs used in production. Major crops grown by farmers like maize, rice, wheat, pepper, tomato, okro, onion, water melon, and amaranthus were measured in kilogrammes. In this study, total yield for the number of crops grown by a respondent was scored as the output divided by the farm size to give crop productivity (Table 5.9). The results show that 28% of beneficiaries realised 3000 and kilogrammes per hectare compared to with 13%. Whereas 1% and 2 % of beneficiaries and non-beneficiaries realised less than 500 kilogrammes per hectare

Table 5.9: Distribution of beneficiaries and non-beneficiaries according to crop productivity (n = 353).

Crop productivity (Output/hectare)	Beneficiaries		Non-beneficiaries	
	Freq	Percent (%)	Freq	Percent (%)
< 500	2	1	3	2
500-900	12	6	30	20
1000-1400	29	14	44	30
1500-1900	44	21	23	16
2000-2400	42	20	13	9
2500-2900	21	10	14	10
3000 and above	57	28	19	13
Total	**207**	**100**	**146**	**100**

Source: Reconnaissance Survey (2014)

Table 5.10 shows the calculated $F_{(1,410)}$ value (225), the F value needed to exceed (F critical = 3.86) in order to have a significant difference between beneficiaries' and non-beneficiaries' crop productivity and the probability (p-value) that the calculated F value obtained by chance (random error) alone. This probability was very small (8.05E-49**)** so there was a highly significant difference between beneficiaries' and non-beneficiaries' crop productivity in the area studied.

Table 5.10: Results of F test of crop productivity of beneficiaries and non-beneficiaries (n= 353).

Sources of variation	SS	df	MS	F	P	Fcritical
Between groups	2124212422	1	2,12E09	225	8,05E-49	3.86
Within groups	3861176975	410	9417505			
Total	5985389397					

5.4.3 Impact on farm income

Analysis of the impact of HVIP on irrigated farm income is discussed as follows:

A. Seeds/Planting material input costs

Table 5.11 on page 85 indicates that the costs incurred in naira per hectare by beneficiaries and non-beneficiaries were ₦71, 525 = 00 and ₦55, 387 = 00. The difference in the costs might not be unconnected to the rising inflation and the acreage cultivated especially with respect to beneficiaries in the study area.

B. Fertilizer input costs

The average cost of the quantity of fertilizer used by the sampled respondents in kilogramme per hectare was estimated at ₦ 202,300 = 00 and ₦ 60, 823 = 00. This showed that beneficiaries spent more money on fertilizer compared to non-beneficiries perhaps, because of the size of cropped area cultivated and/ or as a result of untimely distribution which forced them to source the input in an open market at a higher price.

C. Chemical input costs

Table 5.11 shows that an average sum of ₦49, 536 = 00 and ₦ 53, 987 = 00 was spent. The higher costs of chemicals used by the non-beneficiaries could be due to the vegetables grown compared to the Project beneficiaries.

D. Cost of labour

The average cost of labour showed that beneficiaries spent ₦ 33, 641 = 00 and non-beneficiaries ₦ 55, 709 = 00 respectively. This high cost in the case of non-beneficiaries might not be unconnected to high labour requirements of vegetables compared to cereal crops grown by the Beneficiaries.

E. Fuel costs

Table 5.11 shows that average sums of ₦ 42, 857 = 00 and ₦ 60, 406 = 00 were spent by both beneficiaries and non-beneficiaries respectively. This might not be unconnected to method of water extraction using petrol-driven machines by the non-beneficiaries compared to beneficiaries that utilized gravity system.

F. Fixed costs

In this study, depreciation on farm implements such as hoes, axe, rakes, cutlasses and pumping machines was considered as fixed cost. Depreciation on implements was based on salvage value of the cost of purchasing the implements and a useful life of 2 years and a straight line method was used to compute it. As shown in Table 5.11, an average sum of ₦ 127, 320 = 00 and ₦ 76, 879 = 40 were spent as fixed costs by both beneficiaries and non-beneficiaries respectively. This indicated that there was an increase in the cost in both cases perhaps, due to inflation in the value of naira.

Table 5.11: Cost of inputs used by beneficiaries and non-beneficiaries (n = 353).

Variables N/ha	Beneficiaries	Non-beneficiaries
Seeds	71525	55387
Fertilizer	202300	60823
Chemical	49536	53987
Labour	33641	55709
Fuel	42857	60406
Fixed cost:	127320	76879

Source: Reconnaissance Survey, 2014.

Also, Table 5.12 shows the calculated $F_{(1, 410)}$ value (68.3) for beneficiaries, the F value that was needed to exceed (F critical = 3.86) in order to have a significant difference and the probability (p-value) that the calculated F value obtained by chance (random error) alone. This probability was large (p = 5.66E07) so there was highly significant difference in terms of cost of inputs between beneficiaries when compared to non-beneficiaries.

Table 5.12: Test of variation in cost of inputs between beneficiaries and non-beneficiaries (n= 353).

Sources of variation	SS	df	MS	F	P	Fcritical
Between groups	1500304402	1	1.5E+09	68.3	5.66E07	3.86
Within groups	9001826407	410	21955674			
Total	1.05E+16					

Table 5.13: Net-farm income of beneficiaries and non-beneficiaries (n = 353).

Input N/ha	Beneficiaries	Non-beneficiaries
A.		
Seeds	71525	55387
Fertilizer	202300	60823
Chemical	49536	53987
Labour	33641	55709
Fuel	42857	60406
B.		
Fixed cost:	127320	76879
C.		
Total cost (A + B)	527, 179	363191
D.		
Revenue:		
Rice	1048437	66381
Maize	463719	169040
Wheat		66140
Tomato		456620
Onion		87640
Others		79120
Total revenue:	1512157	766944
Net farm income:	814852	403753

Source: Reconnaissance Survey, 2014.

Table 5.14 shows the calculated $F_{(1, 410)}$ value (726.3), the F value needed to exceed (F critical = 3.86) in order to have a significant difference between beneficiaries' and non-beneficiaries' net farm income and the probability (p-value) that the calculated F value was obtained by chance (random error) alone. This probability is very small (p = 8.56E-93) so there was highly significant difference in terms of net farm income between beneficiaries and non-beneficiaries of the Project.

Table 5.14: Results of F test of net farm income of beneficiaries and non-beneficiaries (n = 353).

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*Fcritical*
Between Groups	2.04E+13	1	2.04E+13	726.3491	8.56E-93	3.864239
Within Groups	1.15E+13	410	2.81E+10			
Total	**3.19E+13**	**411**				

5.4.4 Analysis of poverty status among beneficiaries and non-beneficiaries

To determine the poverty status of households in the study area, a cut-off point was selected to serve as a poverty line across the distribution of the household expenditure per adult equivalent. The use of an absolute line such as X dollars in Purchasing Power Parity (PPP) is rejected due to frequent fluctuations in the country's exchange rate, hence a relative poverty line set at one-third (1/3) of the mean consumption-expenditure was used in identifying the core poor (Anyanwu, 1997). The most commonly used is that of Organisation for Economic Cooperation and Development (OECD) because of its simplicity of use and wide familiarity. The scale is expressed as:

Expenditure = $Exp/n^{0.7}$

Exp = Total household expenditure

n = Household size

0.7 = exponential formation representing other adults in a particular household

Estimating the poverty indices, this study measured the well-being of beneficiaries and non-beneficiaries of Hadejia Irrigation Project by their total consumption-expenditure and by their household size using the adult equivalent scale. Having established the individual number of household consumption-expenditure, one-third (1/3) of the mean consumption-expenditure of the whole sample under study was used to establish a poverty line at ₦12,489.00 for beneficiaries and ₦ 9,961.20 for non-beneficiaries per month per adult equivalent as shown in columns 4 in Table 5.15. From this the p-alpha (poverty index) class of poverty measures was used in determining the head count, depth and severity of poverty among beneficiaries and non-beneficiaries as indicated in columns 8, 9 and 10 of Table 5.15.

The poverty measures indicated in Table 5.15 show that 17% of beneficiaries out of 207 sampled were classified to be living below the poverty line of ₦12, 489.00 while 36% of non-beneficiaries correspondingly live below the poverty line of ₦ 9,961.20. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for non-beneficiaries respectively. This means that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them up to the poverty line. Equally, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries.

However, the poverty lines of ₦ 12,489.00 and ₦ 9,961.20 per month were far below the range with that gotten by FOS (2005) that is ₦23, 733.00. Also, the use of these three (3) measures of poverty clearly indicated that the rates of poverty among beneficiaries and non-beneficiaries of Hadejia Irrigation Project were comparatively low when compared with the total population of the people that are poor in Jigawa state provided by the FOS (2005) that is 95.07, 0.443 and 0.2643.

5.4.4.1 Beneficiaries' poverty analysis

Y = Total expenditure per household equivalent. Each household's expenditure was divided by the household size raised to power 0.7 being the adult equivalent scale expressed thus:

Total expenditure per household equivalent was summed up to give = ₦7, 775, 716.00

Mean expenditure = Total household expenditure divide by the sample size

(₦ 7,775,716.00/207) = ₦ 37,467.2

Z = Poverty line = 1/3 of the mean expenditure = 1/3 (₦ 37, 467.20) = ₦12, 489.00

Total Expenditure of the Poor = Total of all those that are below the Poverty line to give a total of = ₦ 110, 962.70

Average Expenditure of the Poor = Total Expenditure of the Poor divided by the number of those below the Poverty line to give a total of = ₦ 110, 962.7/36 = ₦ 3,467.60

Head Count Ratio = Total number of the Poor (q) divided by the sample population (n) to give = 35/207 = 0.17

Poverty Gap Ratio = Difference between average expenditure of the poor and the Poverty line

= ₦ 12,489.00 - ₦ 3,467.60/₦ 12,489.00 = 0.72 or 72%

Poverty Depth = Multiplying the Poverty Gap Ratio by the Head Count Ratio = 0.17 X 0.72 = 0.12 or 12%

Poverty Gap Ratio = Multiplying the Head Count Ratio by the square of the Poverty Gap Ratio = 0.17 X $(0.72)^2$ = 0.09 or 9%.

5.4.4.1 Non-beneficiaries' poverty analysis

Total expenditure per household equivalent was summed up to give = ₦4, 363, 013.00

Mean expenditure = Total household expenditure divide by the sample size

(₦ 4, 363, 013.00/146) = ₦ 29, 883.70

Z = Poverty line = 1/3 of the mean expenditure = 1/3 (₦ 29, 883.70) = ₦ 9, 961.20

Total Expenditure of the Poor = Total of all those that are below the Poverty line to give a total of = ₦ 105, 501.00

Average Expenditure of the Poor = Total Expenditure of the Poor divided by the number of those below the Poverty line to give a total of = ₦ 105, 501.00/53 = ₦ 1,990.50

Head Count Ratio = Total number of the Poor (q) divided by the sample population (n) = to give a = 53/146 = 0.36

Poverty Gap Ratio = Difference between average expenditure of the poor and the Poverty line

= ₦ 9,961.20- ₦ 1,990.50/₦ 9, 961.20 = 0.8 or 80%

Poverty Depth = Multiplying the Poverty Gap Ratio by the Head Count Ratio = 0.36 X 0.8 = 0.28 or 28%

Poverty Severity = Multiplying the Head Count Ratio by the square of the Poverty Gap Ratio = 0.36 X $(0.8)^2$ = 0.23 or 23%.

Table 5.15: Poverty Analysis between beneficiaries and non-beneficiaries (n = 353).

Category	Y (₦)	ME(₦)	Z (₦)	TEP (₦)	AEP(₦)	HCR=P_O	PGR	PD =P_1	PS =P_2
Beneficiaries	7775716	37467.2	12489	110963	3467.6	0.17	0.72	0.12	0.088
Non-beneficiaries	4363013	29883.7	9961.2	105501	1990.5	0.36	0.8	0.28	0.23

On poverty incidence, depth and severity the project beneficiaries had indexes that include 0.72, 0.12 and 0.09 respectively. This meant that 12% and 9% chances of poverty occurrence and severity. In the case of non-beneficiaries the indexes were 0.8, 0.28 and 0.23 which meant that there was a correspondingly 28% and 23% possibility of poverty occurrence and severity (Figure 3). The results therefore, showed that access to irrigation infrastructure provided by the HVIP had impacted on the dimensions of irrigation via production, income, employment, that led to incrased yield, cropped area, on-and off-farm employment that might have led to reduce poverty severity among beneficiaries compared to non-beneficiaries of the project.

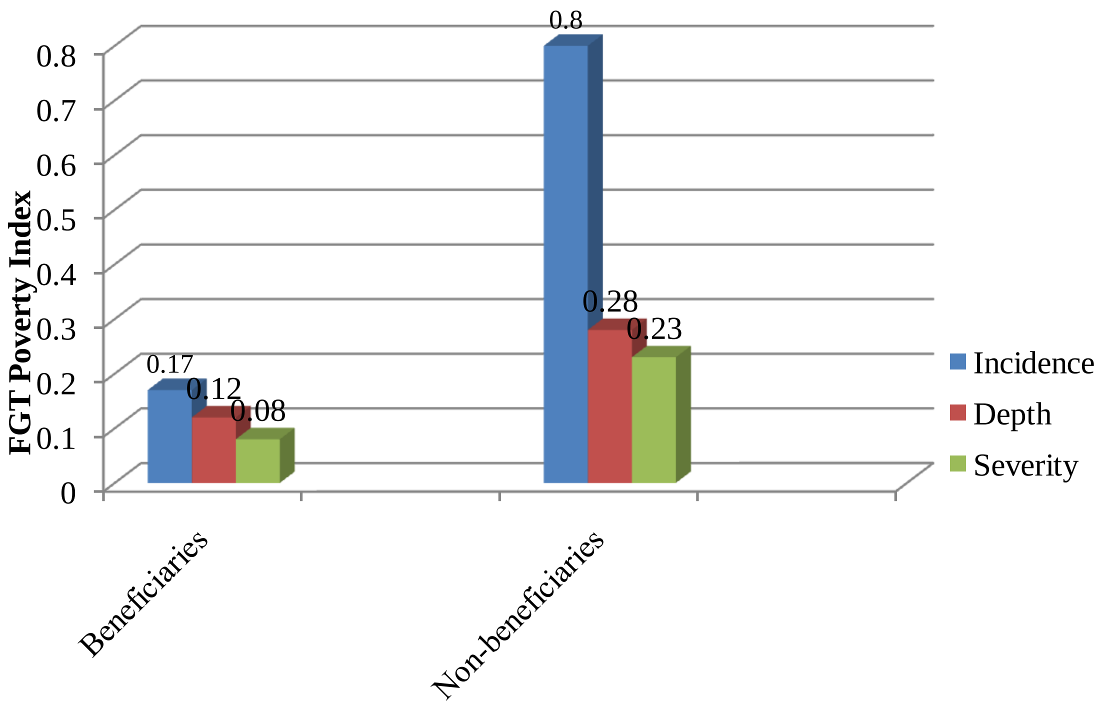

Figure 3: Poverty status of Benefciaries and Non-beneficiaries.

5.4.5 Determinants of poverty among benefciaries and non-beneficiaries

The fifth objective of this study was to assess the determinants of poverty among beneficiaries and non-beneficiaries. From the maximum likelihood estimates of the Tobit regression (Table 5.16), the results show that the model (regression line) fits the data reasonably. For example, the (maximum likelihood) estimates maximised the log likelihood functions. This implied that among all the possible regression lines, the coefficients (b's) of this regression line maximised the joint (total) probability (likelihood) of observing the **n** sample values of the poverty severity. This indicated that variation in poverty severity was explained by the (maximum likelihood) estimates of the explanatory variables, suggesting that the model as specified explained significant non-zero variations in factors influencing poverty severity among beneficiaries.

Furthermore, the Pseudo R-square (coefficient of determination) was 0.56, suggesting that the model has a good fit to the data. This indicated that 56% variation in poverty severity was explained by variations in the specified explanatory variables, suggesting that the model had good explanatory power on the changes in poverty severity among the respondents with 95% level of confidence. However, in the case of non-beneficiaries, the Pseudo R-square (coefficient of determination) was 0.32, suggesting that the model had a less than average good fit to the data. This indicated that 32% variation in poverty severity was explained by variations in the specified explanatory variables, suggesting that the model had less explanatory power on the changes in poverty severity among non-beneficiaries at 95% level of confidence.

The result further shows that at 5% level of significance, the coefficient of age of the household had negative but significant influence on poverty severity among beneficiaries and non-beneficiaries at 10%. This implied that poverty severity would be reduced as age increased indicating that as age increased the probability and intensity of poverty decreased perhaps with capital accumulation from irrigation farming.

The coefficient of household size was significant at 10% level and had a positive relationship with the poverty severity among beneficiaries. Equally, household size had a positive relationship but was insignificant at 10% level with the poverty severity among non-beneficiaries. This implied that a unit increase in the household size would increase the probability of poverty severity in an average household in the study area, and vice versa. This was because the larger the number of less active adults (e.g., the old or the unemployed) and children in a household, the heavier the burden of the active members in meeting the cost of minimum household nutrition and, hence, the higher the level of the probability or intensity of poverty, and vice versa (Omonona, 2001).

The coefficient of level of education had significant and negative relationship with poverty severity among beneficiaries. Correspondingly, the coefficient of level of education had significant and positive relationship with poverty severity among non-project respondents. This meant that a unit increase in the expenditure of a household on education would increase the probability of household poverty intensity and vice versa, suggesting that households with higher expenditure on education were on the average poorer. This might be due to the fact that expenditure on education as an item of priority would deprive a household of some other basic needs. This could have a negative impact on household welfare and increase the intensity of household poverty.

The coefficient of household non-farm income had insignificant and negative relationship with poverty severity in the project area. In the case of non-beneficiaries, the coefficient of household non-farm income had insignificant and negative relationship with poverty severity. This suggested that the probability of poverty intensity was autonomously increased among households whose enterprise structure was restricted to farm production alone in the study area. The implication was that among the rural people, those who engaged in agriculture as a single and sole source of income tended to be poorer than those who combined agricultural and non-agricultural activities. That was, rural households, who were engaged in other occupations, in addition to farming, were often less poor than households that were engaged in farming alone (Omonona, 2001). Hence, literature reported an increased engagement of rural households in non-agricultural income-earning activities in recent years in Nigeria (Yunusa, 1999).

The result in Table 5.16 further shows that at 5% level of significance, the coefficient of irrigation farming experience of the household had negative but significant influence on poverty severity among beneficiaries. It shows that at 5% level of significance, the coefficient of irrigation farming experience of non-beneficiaries had positive but insignificant influence on poverty severity. This implied that poverty severity would be increased with experience in irrigation indicating that as it increased, the probability and intensity of poverty increased. This might perhaps be due to the long gestation period of the project to be completed 1995-2015 only 12% of the total irrigable space was in operation whereas the non-project area used tubewells and flood recession in their farming activities.

The coefficient of household farm size had significant and negative relationship with poverty severity among beneficiaries. The result further, shows that at 5% level of significance, the coefficient of farm size of non-beneficiaries had positive but insignificant influence on poverty severity. This meant that a unit increase in the size of farm holding would lead to a reduction in the probability of household poverty severity and vice versa. Households with larger farm sizes were, on average, less poor than those that cultivated smaller farm sizes. This was because households with larger farm holdings were expected to generate more income, which would enhance their consumption level and subsequently improve their household poverty status. This finding is in agreement with Omonona (2001).

The coefficient of household's access to agricultural extension services was statistically insignificant at the 5% level and shows a positive relationship with poverty severity among beneficiaries. The coefficient of non-beneficiaries' access to agricultural extension services was statistically significant at the 5% level but showed a negative relationship with poverty severity among the households. This implied that households that had access to extension services as such had higher probabilities of being non-poor and vice versa. This might be because contact with extension services could provide more access to improved crop production techniques, improved inputs, and other production incentives. These would positively affect farmers' outputs and their income-generating ability, thereby reducing their poverty level.

The coefficients of membership of cooperative societies or other farmers' associations were insignificant at 5% level and exhibited a positive relationship with household poverty severity among beneficiaries and non-beneficiaries. This meant that the intensity of poverty was higher in a household whose head was a member of a cooperative society or any other farmers' association than in one whose head did not belong to such an organisation. This might be as a result of inefficiency or ineffective services for various benefits that might be accruable to members of cooperative societies, such as credit facilities, access to improved production inputs, and access to information that could enhance their productive capacity.

The coefficient of household head's access to credit had insignificant and negative relationship with poverty severity among the respondents. The coefficient of non-beneficiaries' access to credit also, had insignificant and negative relationship with poverty severity among the respondents at 10%. This meant that the autonomous poverty intensity of households whose heads had access to credit facilities was, on average low. This might be due to the collateral requirements, untimely and cumbersome nature of access credit from sources like commercial banks and other financial institutions. This would subsequently undermine the household's income-generating ability and household welfare. This result was not similar with the result of FOS (1999).

The coefficients of subsidy and cost of labour among beneficiaries were positive and insignificant at 5% level but, had a very low negative relationship with poverty severity among non-beneficiaries. Further the result in Table 5.16 shows that at 10% level of significance, the coefficient of reaches of the household had positive and insignificant influence on poverty severity among beneficiaries and significant for non-beneficiaries. This implied that poverty severity would be increased as distance to water source increases indicating effect of location in the study area.

Table 5.16: Tobit regression results of poverty determinants between beneficiaries and non-beneficiaries (n = 353).

	Beneficiaries			**Non-beneficiaries**		
Variable	**ML Estimate**	**t-Ratio**	**P**	**ML Estimate**	**t-Ratio**	**P**
Constant						
Age	-480.61	2.29*	0.023	-4879.1	- 1.54**	0.125
Household size	215.908	1.69**	0.097	2542.21	1.25	0.213
Level of education	-389.89	-3.672**	0.151	2822.64	0.67	0.57
Non-farm income	-0.0059	-0.76	0.444	-0.0869	-0.81	0.419
Irrigation farm experience	347.186	2.55*	0.012	3893.05	1.64**	0.104
Farm size	-1374.6	-1.5**	0.135	4010.62	0.31	0.756
Extension visit	397.351	0.53	0.6	-11234	-0.91	0.362
Water Users' Association	2358.9	0.63	0.531	40995.6	0.67	0.503
Credit	-0.0412	-1.74**	0.084	-0.1868	0.552	0.375
Subsidy	0.08601	1.85**	0.065	-0.5963	0.89	0.461
Cost of labour	0.05038	0.97	0.33	-0.783	-0.74	0.856
Reaches	630.855	1.16	0.247	1840.7	0.18	0.001
Log likelihood =	-2001.2			-1984.8		
Pseudo R2 =	0.56			0.32		

Source: Reconnaissance Survey (2014)
** t ratio Significant at 1% level of significance
* t ratio Significant at 5% level of significance

5.4.6 Test of hypotheses

The following hypotheses were tested in this research work: Null hypothesis: $\mu d = D$, Alternative hypothesis: $\mu d \neq D$, Number of tails = 2 therefore, an extreme value on either side of the sampling distribution would cause a researcher to reject the null hypothesis (StatTrek.com, 2015):

There was no significant impact of HVIP on access to irrigation water on beneficiaries at head, middle and tail-ends areas of the project. A paired *t*-test was performed to ascertain whether the opinions of beneficiaries with respect to access to irrigation water were different. The null hypothesis on water availability was rejected at the head, middle and tail-end villages. This showed that water availability in the Hadejia Valley Irrigation Project was associated with the position of the farmers on the water course. Farmers who were at the head had better access to water as compared to those who were at the tail of the water course. In terms of percentages, 87%, 98% and 100% of beneficiaries at head, middle, and tail end asserted that there was water availability in the Hadejia Valley Irrigation, only 13% and 2% at head and middle reach viewed there was water unavailability. The t (19) = 1.571, 1.518, and 1.448, p = 0.399, 0.319 and 0.437 at head, middle and tail-end were less than the t-critical (1.96) at 0.05% level of significance.

In addition, the null hypothesis on equality of water distribution was rejected at the head, middle and tail-end villages. This shows that equality of water distribution in the Hadejia Valley Irrigation Project was associated with the position of the farmers on the water course. Farmers who were at the head had better access to water as compared to those who were at the tail of the water course. In terms of percentages, 90% and 95% of water users at the head and middle reach had received water equally. Whereas, 10%, 5% and 89% of water users at the head, middle and tail-end reach had received water fairly equal and 11% not equal at tail-end. The $t(19)$ = 1.554, 1.513 and 1.554, p = 0.4, 0.319 and 0.428 at head, middle and tail-end were less than the t-critical (1.96) at 0.05% level of significance.

Also, the null hypothesis on satisfaction with water distribution was rejected at the head, middle and tail-end villages. This demonstrated that satisfaction with water distribution in the Hadejia Valley Irrigation Project was associated with the position of the farmers on the water course. Farmers who were at the head had better access to water as compared to those who were at the tail of the water course. In terms of percentages, 98% and 63% of beneficiaries at head and middle reach were satisfied with water distribution in the Hadejia Valley Irrigation, only 2% at head reach and 100% at tail-end were not satisfied with water distribution in the Hadejia Valley Irrigation. The t (19) = 1.426, 1.364, and 1.431, p = 0.408, 0.338 and 0.438 at head and tail-end were greater but, at the middle less than the t-critical (1.96) at 0.05% level of significance.

But, on water charges in the Hadejia Valley Irrigation Project between head, middle and tail-end the null hypothesis was rejected at the head, middle and tail-end villages. This showed that payment of water charges in the Hadejia Valley Irrigation Project was associated with the position of the farmers on the water course. In terms of percentages, 25%, 37% and 24% and 63% of beneficiaries at head, middle and tail-end paid at the beginning of the season. 7% and 16% at head and middle reach paid in the middle of the season. 68%, 48% and 76% of beneficiaries at head, middle and tail-end paid at the beginning of the season.The t(19) = 2.153, 1.909, and 2.233, p = 0.371, 0.276 and 0.403 at head, middle and tail-end were greater than the t-critical (1.96) at 0.05%. Therefore, HVIP had impacted on access to irrigation water in the command area.

There was no significant impact of HVIP on irrigation cropped area under irrigation activities of beneficiaries in the study area. A paired t-test assuming equal variances using a pooled estimate of the variance was performed to test the hypothesis that the resulting mean cropped area of beneficiaries and non-beneficiaries was equal. The mean cropped area of beneficiaries (*M* = 50.74, *SD* = 121.68, *N* = 19) and that of non-beneficiaries (*M* = 34, *SD* = 59. 87, *N* = 19), *t* (18) = 1.817, *p* = 0.043 was less than *t* critical (1.96) at 0.05% level of significance. Also, the mean cropped area of beneficiaries between head (*M* = 27.89, *SD* = 65.087, *N* = 18) t = 1.866, p = 0.039, middle (*M* = 24.26, *SD* = 58.96, *N* = 18), *t* (18) = 1.794, *p* = 0.045, tail end (*M* = 16.89, *SD* = 54.38, *N* = 18), *t* (18) = 1.600, *p* = 0.064 were less than *t* critical (1.96) at 0.05% level of significance. Consequently, the null hypothesis on no significant impact of HVIP on irrigation cropped area under irrigation activities of beneficiaries in the study area was rejected. As such, HVIP had impacted on irrigation cropped area between beneficiaries and non-beneficiaries and within the command area of the project.

There was no significant impact of HVIP on poverty reduction among beneficiaries and non-beneficiaries in the study area. The poverty measures indicated in Table 5.15 show that 17% of beneficiaries were classified to be living below the poverty line of ₦12, 489.00 while 36% of Non-beneficiaries correspondingly lived below the poverty line of ₦ 9,961.20. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for Non-beneficiaries respectively. This meant that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them within up to the poverty line. Equally, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries.

The result in Table 5.16 further shows that at 5% level of significance, the beneficiaries' probability of poverty was determined by age, t-ratio = 2.29, level of education, t-ratio = -3.76, *P* = 0.151, non-farm income, t-ratio = -0.76, *P* = 0.444, farm size, t-ratio = -1.5, *P* = 0.135 and credit, t-ratio = -1.74, *P* = 0.084. However, the non-beneficiaries' probability of poverty was determined by age, t-ratio = 1.54, non-farm income, t-ratio = -0.81, P = 0.419, extension visit, t-ratio = -0.91, P = 0.362, and cost of labourt t-ratio = -0.74, P = 0.856. Consequently, the null hypothesis on no significant effect of HVIP on poverty reduction among beneficiaries in the study area was rejected. As such, HVIP had impacted on poverty reduction among beneficiaries in the study area.

5.4.7 Poverty reduction strategies in the HVIP

A. Crop productivity

The state under this study covers a landmass of about 22,410 Sq/km, and the bulk of agricultural production is undertaken by small-scale farmers using family labour, capital and management. Major crops grown are: millet, sorghum, rice, wheat, cowpea, groundnut, maize, sesame, vegetables and cotton. Livestock such as cattle, sheep, goat and poultry are also raised. The cropping pattern is mixed cropping with few farmers practicing sole cropping. The major crop mixtures are millet/sorghum, millet/cowpea or millet/groundnut. Agriculture in the state as in other peasant settings is characterised by low levels of production as a result of the use of manual tools, inadequate credit facility, high level of risks (drought, flood, pests and diseases) and illiteracy. In this study, Major crops grown by farmers like maize, rice, wheat, pepper, tomato, okro, onion, water melon, and amaranthus were measured in kilogrammes. In this study, total yield for the number of crops grown by a respondent was scored as the output divided by the farm size to give crop productivity (Table 5.9). The results show that 28% of Beneficiaries realised 3000 and kilogrammes per hectare compared to Non-beneficiaries with 13%. These findings might not be unconnected to the cropped area under irrigation activities of beneficiaries in the Project than Non-project area (Figure 4).

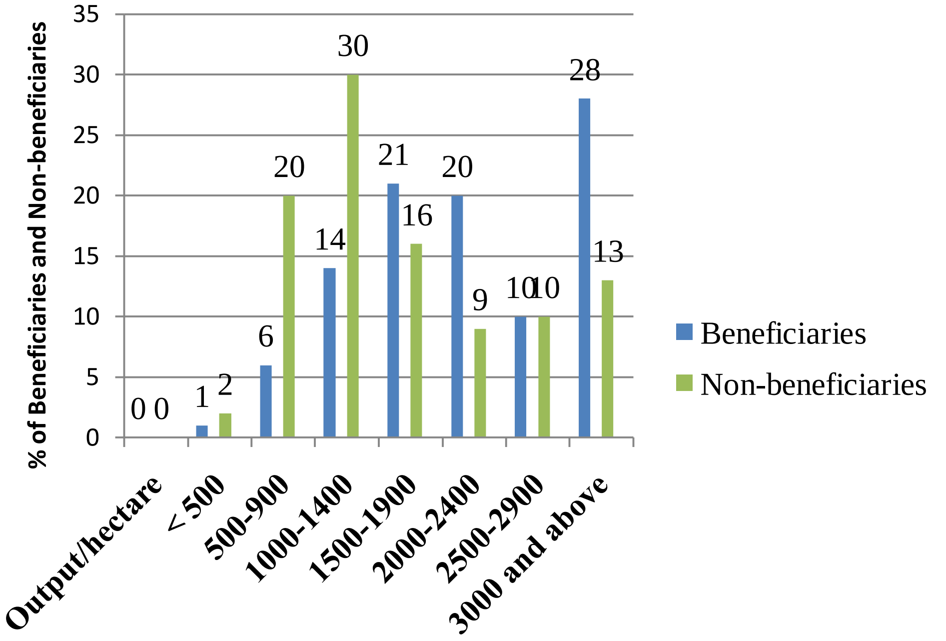

Figure 4: Crop productivity per hectare

B. Distribution of farm lands among crops

The distribution of farm lands among crops indicated that rice (76%) and maize (24%) were the dominant crops grown by the Project beneficiaries whereas apart from rice (48%) and maize (43%) non-beneficiaries cultivated other crops in the following order: other crops (5%), wheat (4%), onion and tomato (0.3% each). The implications of these findings are that while Project beneficiaries were moving towards specialisation non-beneficiaries diversified their crop production activities (Figure 5).

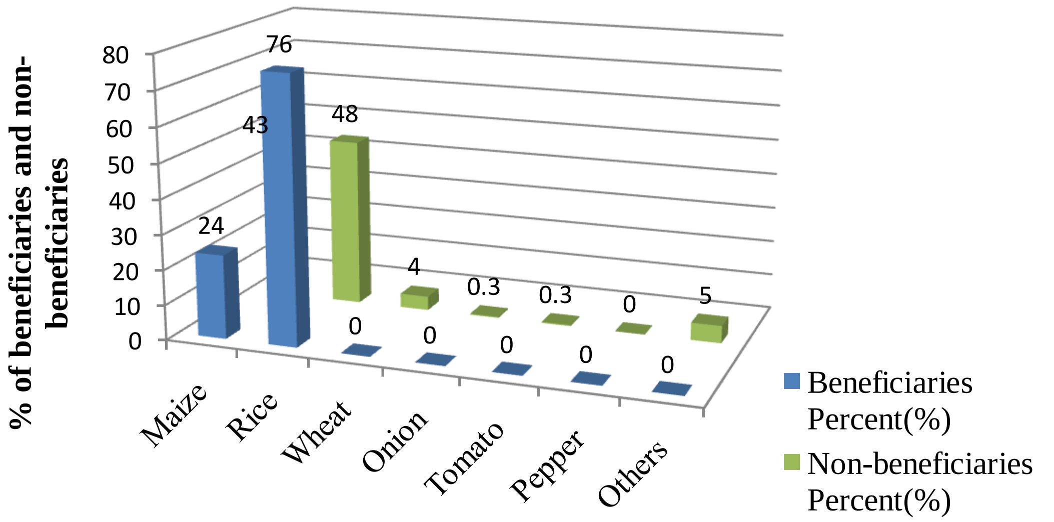

Figure 5: Distribution by irrigated cropped area.

C. Income and expenditure profiles of households

i. Income from agriculture and off-farm activities

The sale of crops was a major source of income for farm households in the study area. Cattle (74% and 28%), sheep (25% and 28%) and goats (10% and 13%) were seen as a kind of medium to long-term investments in the project and non-project areas respectively hence, these were sold only in dire circumstances. Poultry (0% and 14%) were however, readily sold as a source of income. Sales of vegetables and petty off-farm employment were also common sources of income (Figure 6).

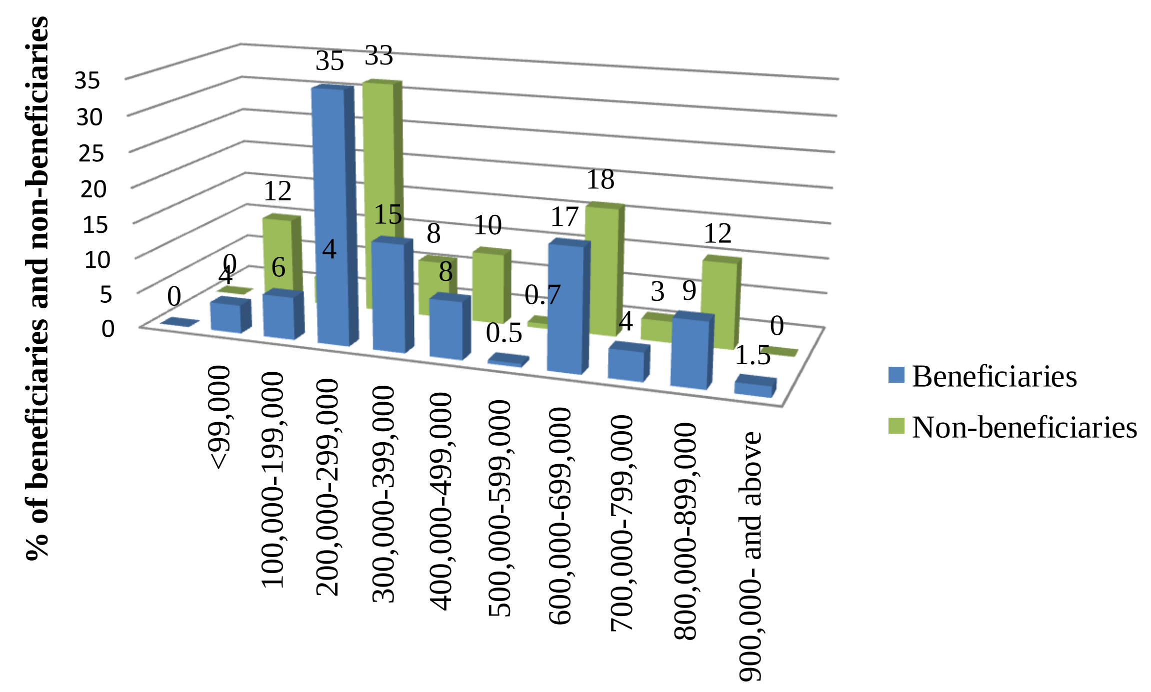

Figure 6: Distribution of farm income in 000's naira.

In addition to the sale of farm produce, all the farm households interviewed in the Project and Non-project areas were involved in other off-farm activities as additional sources of income and food security. Some respondents (23%) were into fishing, (22%) engaged in trading as additional income earning activity. Moreover, (18%) in commercial transportation, (16%) practiced bricklaying, hunting (8%) while (4%) worked as hired labourers and animal traction by the beneficiaries. And 2% each in water vending and equipment repairs as additional income earning activities in the area in the case of project beneficiaries. On the other hand, 2% of non-beneficiaries engaged in repairs of water pumps while 5% reported hired labour and trading as additional income earning activity that brought additional income to them. Moreover, 17% of non-beneficiaries stated commercial transportation, bricklaying and animal traction. Fishing was affirmed by 32%. As such these findings indicated that the people now have diverse pathways by which they can enhance their living conditions consequently, these complementary activities (employment opportunities) have great potentials to contribute to the current fight against poverty in Jigawa state in particular and Nigeria at large (Figure 7).

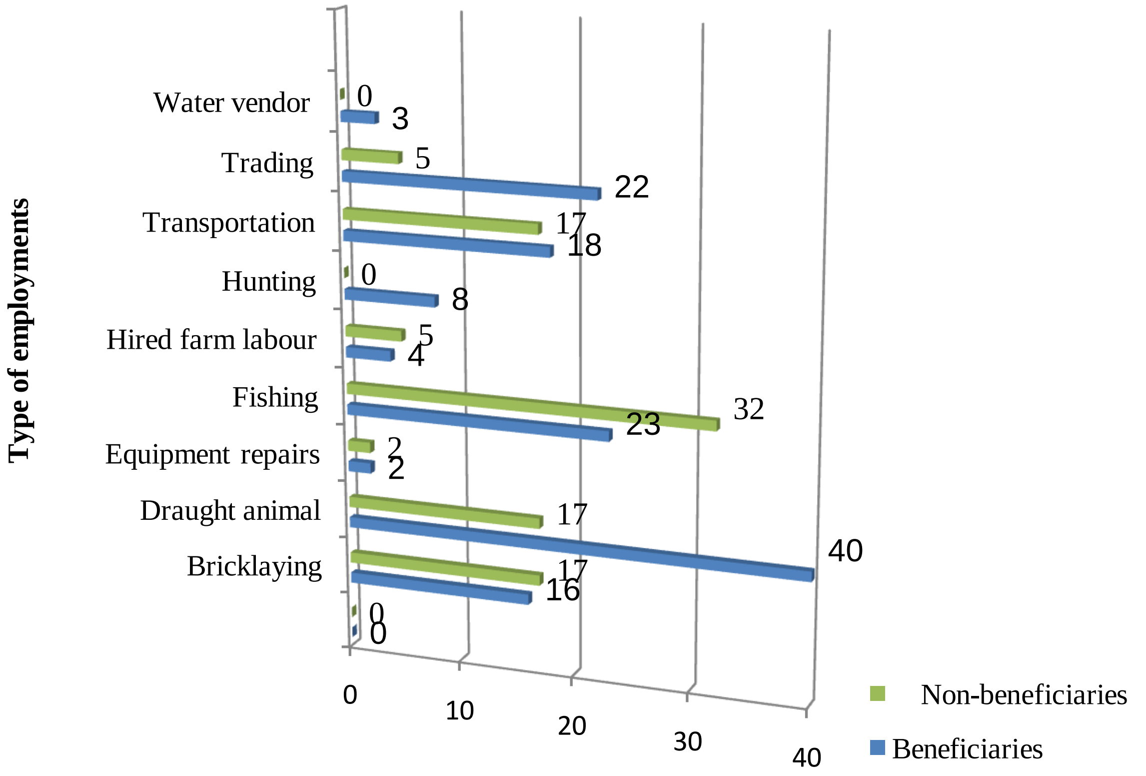

Figure 7: % of beneficiaries and non-beneficiaries

ii. Expenditure profiles

Given the wide range of needs and the limited availability of resources, farm households must make rational decisions on the components and volumes of expenditure. The expenditure baskets of farm households in the study area could broadly be classified as necessities and life style commodities. A large proportion of respondents' income was spent on household necessities, including the purchase of staple food items (feeding 36% and 44% for beneficiaries and non-beneficiaries).

The farm households also, spent a considerable amount on medical bills (37% and 44% ranked 1st in both cases), education (36% ranked 2nd by beneficiaries and 33% ranked 7th), energy (fuel, firewood; 36% and 43% ranked 2nd), clothing (33% and 41% ranked 3rd). It is worth noting that the respondents as well contributed some of their income to the society in form of social contributions (entertainment 33% and 44% ranked 3rd and 1st). Some life style expenditure items of the farm households include lighting (29% and 26% ranked 5th and 9th) and repairs (house; 30% and 28%; ranked 4th and 8th; automobile; 22% and 40% ranked 6th and 4th; equipment repairs; 20% and 38% ranked 7th and 5th) (Table 5.17).

Table 5.17: Expenditure profile of beneficiaries and non-beneficiaries of (n= 353).

	Beneficiaries			**Non-beneficiaries**		
Type of Expenditure	**Freq**	**Percent (%)**	**Ranking**	**Freq**	**Percent (%)**	**Ranking**
Automobile repairs	45	22	6th	58	40	4th
Childrens' education	75	36	2nd	48	33	7th
Clothing	68	33	3rd	60	41	3rd
Energy	75	36	2nd	63	43	2nd
Entertainment	68	33	3rd	62	44	1st
Equipment repairs	41	20	7th	56	38	5th
Feeding	75	36	2nd	62	44	1st
Healthcare	77	37	1st	62	44	1st
House repairs	62	30	4th	41	28	8th
Lighting	60	29	5th	38	26	9th
Others	0	0		53	36	6th

Source: Reconnaissance Survey (2014)

B. Household resource endowments and wealth status

Various forms of resources were identified with the farm households involved in the study. Access to these resources varied across project and non-project areas. The level of resource endowment was a useful measure of the wealth status of a given household. It was further stressed that rather than looking only at land or other classic wealth indicators for agricultural technology impact the Sustainable Rural Livelihood Framework (SRLF) suggested consideration of an asset portfolio of five types of assets:

a. **Access to human capital assets** denotes the physical assets which have been produced by human activity but, which were not yet utilised. Capital is needed for any kind of productive activity. Access to human capital assets in this study area include: education, skills, knowledge, health, nutrition, and labor power. Agricultural activities in the surveyed Project and Non-project areas were largely carried out using manual labor.

The farm family was actually the key source of labor in farm operations. The results suggested a relatively better access to labor resources among households with a range of 16-20 persons scoring highest percentage (38%) in the project area while 6-10 persons scored (46%) in the non-project. It implied that the area was dominated by large house holdings. This also, suggested that the respondents had adequate family labour to cultivate large farm sizes as exemplified by category of medium and large farmers in the project and small farmers in the non-project area**.**

Differentials in the educational levels of respondents interviewed in the sixteen surveyed villages were large. Analysis of results statistics showed that Quranic form of education is prevalent in which many of the respondents had their highest formal training. The prevalence of Quranic (95%) in the project and non-project areas (36.3%) may not be unconnected with traditions of the area. Similarly, tertiary education scored (38%) in the project and (2.3%) in the non-project area (Table 5.1). On skills acquisition the findings of this study revealed that there were a wide range and diverse sources in acquiring skills in pump operation in the communities studied as shown in Figure 8.

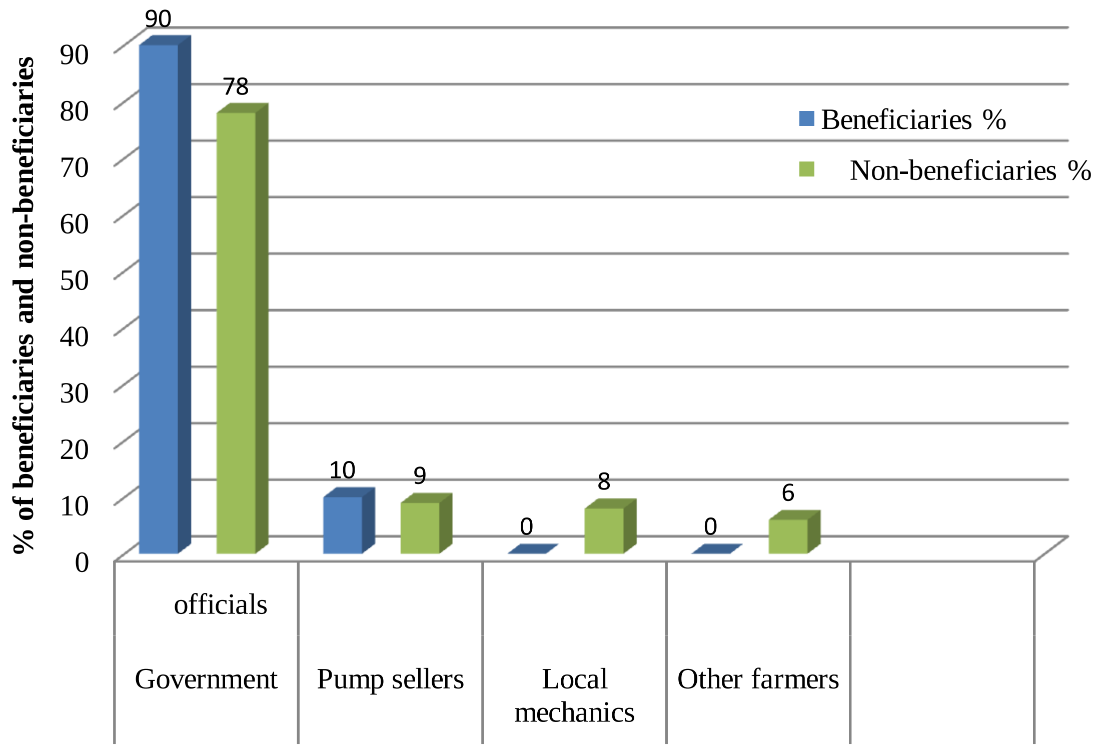

Figure 8: Distribution of sources of training

ii. **Access to natural/land capital assets** consisted of: land, water, forest, marine resources, air quality, erosion protection, and biodiversity. Type of land ownership revealed that 99 percent of beneficiaries and 72 percent of non-beneficiaries acquired their land through inheritance respectively. Also, about 19 percent of non-beneficiaries perhaps, despite the increasing pressure on land resources due to the increasing population continued to hire land and acquired it through gifts (Figure 9).

However, the total cropped area in the project was 658 hectares (maize 156 has and rice 502 has) and 278 in the non-project area (maize 132 has and rice 146 has). This showed that beneficiaries allocated more land area to both crops in the project than non-project area. The results showed that (90%) at head, (95%) at middle reaches deemed it that irrigation water was equal between reaches and only (10%) and (5%) thought it fairly equal but, (89%) and (11%) of tail-end beneficiaries considered irrigation water to be fairly equal and not equal respectively. On the level of satisfaction, (98%) and (100%) of beneficiaries at head and middle reaches of the project presumed that they were satisfied with irrigation water in the project however, only (1%) at head and (100%) at tail-end of the project were not satisfied (Table 5.3). The results of the study showed that there were wide differences in time of payment of water charges in the project area. At the beginning of the season, 25%, 37% and 24% of the beneficiaries testified making payment at head, middle and tail reaches. In the middle of the season, 7%, 16% and 0% whereas 69%, 48% and 76% of head, middle and tail reaches reported making payment of water charges. On marine resources both beneficiaries and non-beneficiaries (23% and 32%) reported fishing as an additional employment opportunity. In terms of environmental conservation 99% of project beneficiaries pointed that they were ready to contribute whereas only 4% of the non-project beneficiaries were ready. When asked why they could not conserve the environment 98% of project beneficiaries indicated to lack of money as the major reason while 98% of the non-project beneficiaries pointed to other reasons.

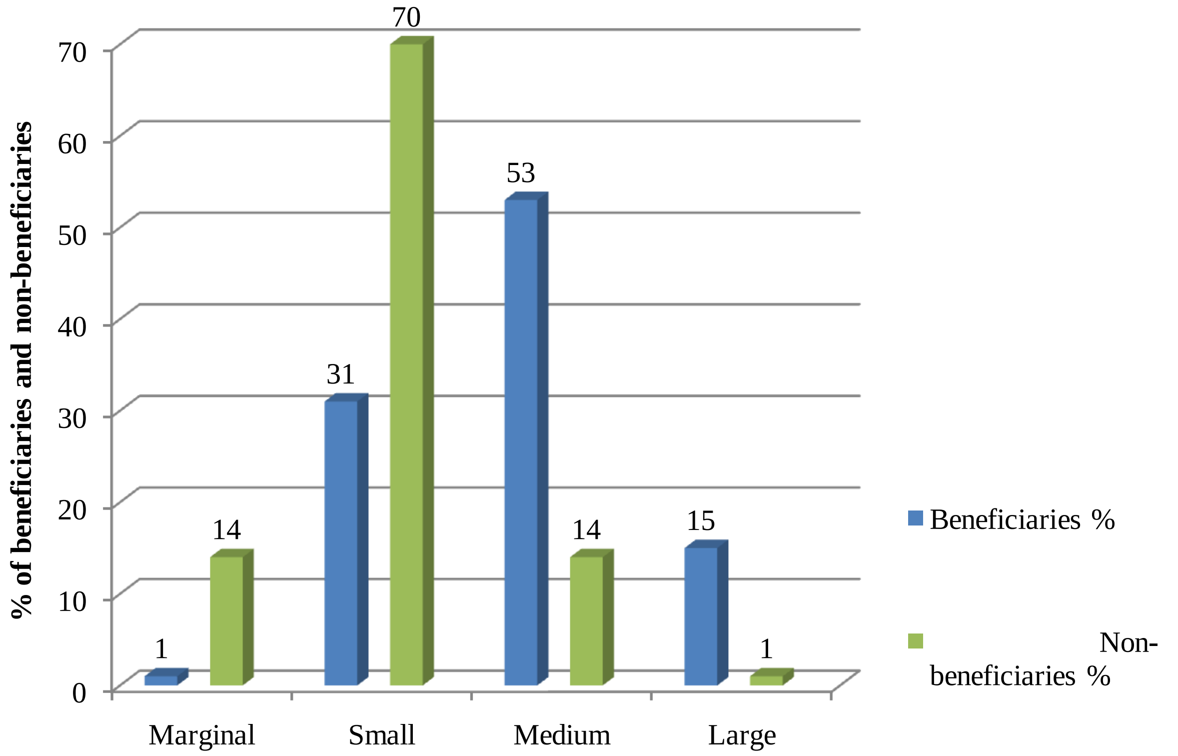

Figure 9: Classification of farmers.

a. **Access to physical assets** in this study bordered on: transportation, roads, buildings, shelter, water supply and sanitation, energy, technology, communications, or other household assets.There were different types of dwelling typical of households in the study area. These include: mud huts, brick and block houses with different roofing materials, as well as poleand *dagga* houses with grass thatched roofs. Households in the survey location owned and had access to different physical assets. Mud (64% and 19%) and concrete houses (4% and 0%) were the common forms of dwelling in the project area while mud houses were more common in the non-project area, employing a very traditional housing technology and were widely used by households in both areas. Although these were relatively cheaper to construct they could easily be destroyed during the rainy season as exemplified by the amount of house repairs (30% and 28%) (Table 5.18). In any case, households who could afford either type of houses were regarded as well endowed.

Tractor and pumping machine used in farm operations and lifting water for irrigation were each owned by 4% of beneficiaries while none of the non-beneficiaries owned a tractor, about 25% owned pumping machines. Both 1% of beneficiaries and non-beneficiaries acquired a car. Motorcycle was acquired by 44% and 23% of beneficiaries and non-beneficiaries respectively. Bicycles were predominantly used for transport in northern Nigeria and about 23% of non-beneficiaries in the study area owned at least one bicycle but, no beneficiaries owned a bicycle.

Refrigerator was owned by 1% each of the respondents whereas generator was only owned by 1% of the non-beneficiaries. As important sources of information and entertainment for majority of the sampled households radio and video were acquired by 3%. And television was owned by only 1% of the beneficiaries. These information and communication tools were owned by 32%, 3% and 4% of the non-beneficiaries respectively. Although not common in the sampled households in Project area about 1% of households in non-project area owned VCD and satellite whereas 17% acquired a rechargeable lamp.

Table 5.18: Proportional distribution of assets of beneficiaries and non-beneficiaries (n= 353).

Assets	Beneficiaries Freq	Beneficiaries Percent (%)	Non-beneficiaries Freq	Non-beneficiaries Percent (%)
A. Buildings:				
a. Mud house	141	68	28	19
b. Concrete house	8	4	0	0
B. Farm equipment:				
a.Tractor	83	40	0	0
b. Pumping machine	8	4	37	25
C. Vehicles:				
a.Car	2	1	2	1
b. Lorry	0	0	0	0
c. Motorcycle	91	44	34	23
d. Bicycle	0	0	25	17
D.Electrical appliances:				
a. Refrigerator	2	1	2	1
b. Generator	0	0	2	1
E. Electronics:				
a. Radio	6	3	32	22
b. Video	6	3	4	3
c. Television	2	1	6	4
d.VCD	0	0	2	1
e. Satellite	0	0	2	1
f. Rechargeble lamp	0	0	25	17
F.Farm animals:				
a. Catlle	153	74	41	28
b. Sheep	52	25	41	28
c. Goats	10	5	19	13
d. Poulty	0	0	20	14

Source: Reconnaissance Survey, 2014.

vi. Access to financial assets included**:** savings (cash as well as liquid assets), credit (formal and informal), as well as cash inflows (state transfers and remittances). As mentioned above, the status of financial resources was a key determinant of the size of arable crop lands in the study area. Access to credit or the availability of financial resources facilitated timely access to adequate inputs for the implementation of all field operations. Access to credit could motivate farmers to invest adequately in newly improved technologies. Results from the study, however, showed minimal access to credit and credit facilities in the two areas. The mean difference in credit for project beneficiaries and non-beneficiaries ranged from ₦ 52,771 = 00 -₦ 50,205 = 68 naira respectively. But, 27% and 44% of both project and non-project farmers indicated none response in access to credit.

Although a relatively higher proportion of the project beneficiaries have access to credit, the average amount of credit received was far lower in the non-project areas. Further interactions with key informants (KI) revealed that some of the households that did not have access to credit were not aware of the availability of credit facilities. Sometimes this might be due to the perceived bureaucratic processes associated with credit delivery, the high interest rates charged on credit and the need for collateral. On non-farm incomeresults of the study showed that most of the project beneficiaries received a low mean off-farm income of ₦ 137, 797 = 00 compared with non-project beneficiaries ₦ 237, 104 = 00 naira.

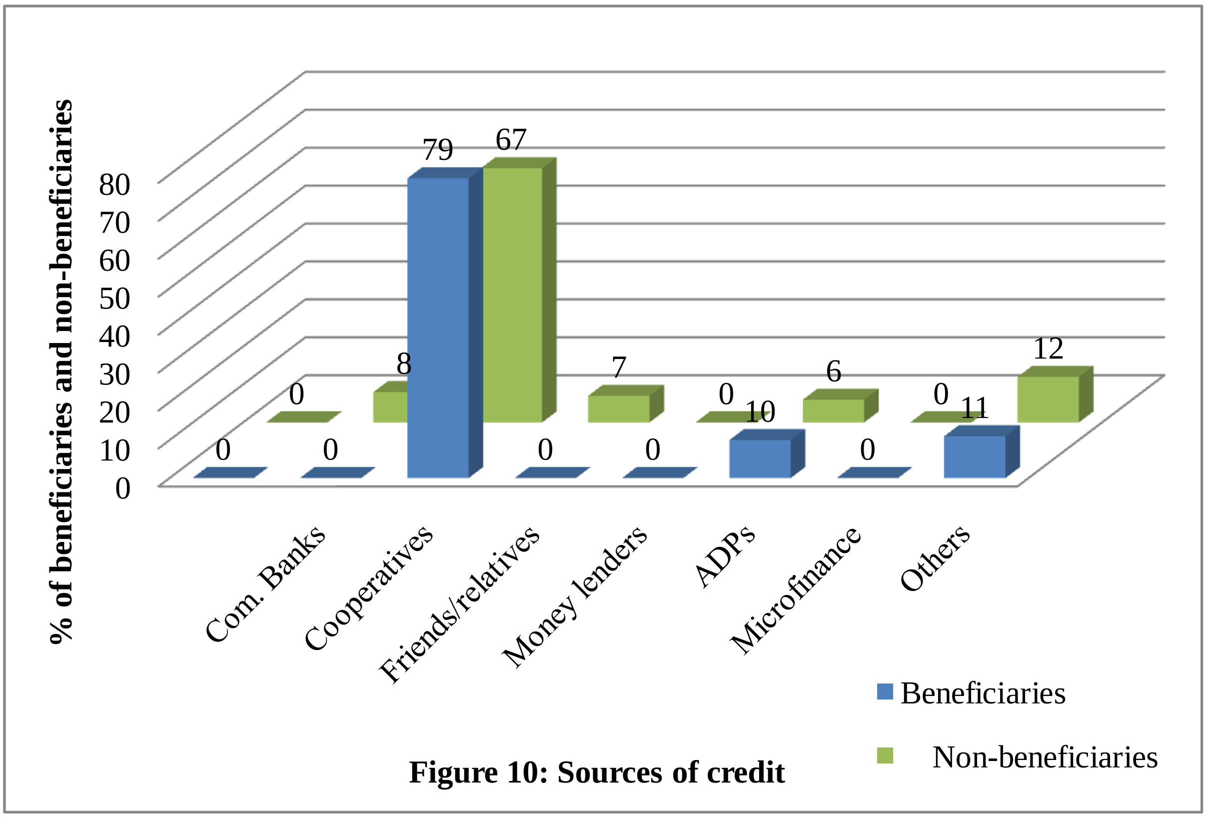

Figure 10: Sources of credit

Cooperatives were used by 79% and 67% of both beneficiaries and non-beneficiaries. ADPs were utilised by 10% and 6%, others were used by 11% and 12% respectively. However, while nobeneficiary pursued commercial banks, friends and relatives, 8% and 7% of non-beneficiaries harnessed credit from them. One of the interesting findings was that no respondent utilised microfinance as a source of credit in the study area despite the existence of one in Hadejia (the emirate headquarters) (Figure 10).

v. **Access to institutional and social assets** comprised of: networks that increase trust, ability to work together, access to opportunities, reciprocity; informal safety nets; and membership in organisation. Results of membership of cooperative societies also, showed that 100 % and 56% of the project and non-project beneficiaries belonged to the social organisation registered under the scheme (WUA and FUA for the non-project area), an indication that the more farmers participated in cooperative societies, and coud lead to better ideas, more knowledge and other benefits.

The findings in Table 5.1 on page **75** revealed that a mean of 5 and 3 of extension visits were received by project and non-project beneficiaries.This implied that both categories had access to extension services. On the ability to work together, 100% of both project and non-project beneficiaries were satisfied with their neighbours as such the environment studied was conducive. However, on access to opportunities, 100% of beneficiaries obtained water pumps from open markets whereas 84% of non-beneficiaries utilised the same source with 16% obtained from government perhaps, through the National Fadama Programme.

Access to services such as roads was mentioned by 98% of beneficiaries whilst no services were pointed by the non-beneficiaries in the study area. Experiences in cooperative associations were more varied in the project than non-project area. Durations that range from 1-5 years 45%; 16-20 years 23% were reported in the project area whereas in the non-project area 1-5 years scored 68% and <1 year 38%. On reciprocity, 92% and 70% of both beneficiaries and non-beneficiaries pointed to information source as the major benefit of being in associations. Access to finance was mentioned by 8% and 7% respectively. In the case of non-beneficiaries access to goods, services and labour were pointed by 15% and 8% of non-beneficiaries (Figure 11).

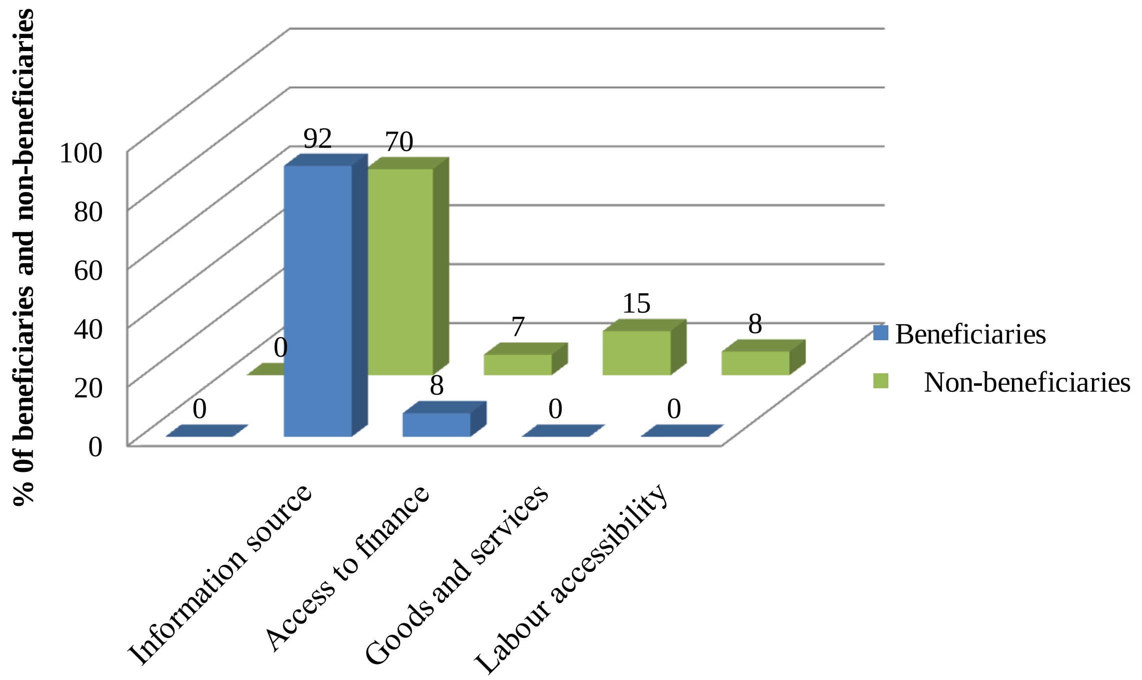

Figure 11: Distribution of WUA/FUA benefits

5.4.8 Households' coping mechanisms

Crop production and livestock rearing were the main livelihood sources for rural farm households in the study area. Respondents also engaged in off-farm income generating activities. However, one of the coping strategies used by both beneficiaries and non-beneficiaries against production risks was ensuring consistent access to water lifting facilities such as pumping machines. Also, varying the allocation of land to major crops was another coping strategy employed by both beneficiaries and non-beneficiaries. The study had also identified variations in the behavior of both beneficiaries and non-beneficiaries. Both specialised and diversified their irrigation activities.

Further, almost all the sampled respondents in the study area owned at least one motorcycle, which was an important means of transportation. Radios, video, VCD and satellite were important sources of information and entertainment in the households. Given the wide range of wants, respondents ought to make rational decisions on the component and volume of expenditure. The revenue from the sales of harvested irrigation produce was spent on education, health care, clothing, shelter, equipment, automobile and other domestic needs.

5.5 Constraints Faced by the Beneficiaries and Non-beneficiaries in the Implementation of the Project

The sixth objective of this study was to identify constraints faced by beneficiaries and non-beneficiaries in the Implementation of Hadejia Valley Irrigation Project. In spite of the contribution of the project to improve rural poverty reduction through the provision of rural employment (agricultural production and income earning opportunities) it was found that farmers in the project and non-project area faced some constraints.

Environmental constraints faced by beneficiaries were**:** Siltation 20%; waterlogging 18%: water pollution 15%; soil erosion 11%; flooding 4%; and high humidity 6%. However, (22%) of non-beneficiaries pointed flooding as the major constraint they faced in their farming activities. On health constraints, the results indicated that typhoid 31%; cholera 29%; malaria 22%; schistosomiasis 16%; ringworm 1.5%; and nematodes 0.5% were mentioned as health constraints faced by project beneficiaries. But, no non-beneficiary had indicated otherwise. Also, on crop-related constraints Quela birds 18%; weed infestation 21% and plant diseases such as blast and rust 21%; rodents 10%; and insect pests 9% were mentioned as health constraints faced by project beneficiaries but, no non-beneficiary had indicated otherwise (Table 5.19).

Results in Table 5.20 shows that some of the physical constraints encountered by both beneficiaries and non-beneficiaries included: high cost of farm inputs 100%; delay in the distribution of farm inputs 75%; low level of western literacy; high cost of land; and poor infrastructure scored 31% each; loss of farm land 29%; poor working environment 6%;

poor service 4% were reported by project beneficiaries. However, major constraints faced by non-beneficiaries were: fuel (14%); fertilizer (12%); tractor hire (8%); credit (6%); produce price (3%) and seeds (2%) but, no beneficiary had indicated otherwise. In the same way, poor water management (48%); construction works (27%); excessive fertilizer (15%) and agrochemicals use (10%) were mentioned as institutional constraints faced by the project beneficiaries.

Table 5.19: Distribution of beneficiaries and non-beneficiaries according to environmental, health and crop-related constraints (n= 353).

Constraints	Beneficiaries		Non-beneficiaries	
	Freq	Percent (%)	Freq	Percent (%)
Environmental:				
Siltation	42	20	0	0
Waterlogging	37	18	0	0
Water pollution	30	15	0	0
Erosion	23	11	0	0
Flooding	8	4	32	22
Humidity	13	6	0	0
Health:				
Typhoid	65	31	0	0
Cholera	60	29	0	0
Malaria	46	22	0	0
Schistosomiasis	32	16	0	0
Ringworm	1	1.5	0	0
Nematodes	1	0.5	0	0
Crop-related:				
Quela birds	38	18	12	8
Weed infestation	43	21	32	22
Plant diseases	43	21	2	1
Rodents	21	10	0	0
Insect pests	19	9	0	0

Source: Reconnaissance Survey, 2014.

Table 5.20: Distribution of beneficiaries and non-beneficiaries according to institutional and physical constraints (n = 353).

Constraints	Beneficiaries		Non-beneficiaries	
	Freq	Percent (%)	Freq	Percent (%)
Institutional:				
Poor water management	100	48	0	0
Construction works	56	27	0	0
Excessive fertilizer use	30	15	0	0
Excessive agrochemical use	21	10	0	0
Physical:				
High cost of farm inputs	207	100	0	0
Delay in input distribution	156	75	0	0
Low western education	65	31	0	0
High cost of farm land	65	31	0	0
Poor infrastructure	65	31	0	0
Loss of farmland	60	29	0	0
Poor working environment	13	6	0	0
Poor irrigation services	9	4	0	0
Fertilizer	0	0	18	12
Fuel	0	0	20	14
Labour	0	0	3	2
Credit	0	0	8	6
Produce price	0	0	4	3
Seeds	0	0	3	2
Tractor hire	0	0	12	8

Source: Reconnaissance Survey, 2014.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

The overall objective of this study was to analyse the impact of Hadejia Valley Irrigation Project (HVIP) on crop productivity and poverty reduction among beneficiaries in the study area. The specific objectives were to: i) describe the socio-economic and institutional characteristics of beneficiaries and non-beneficiaries of Hadejia Valley Irrigation Project; ii) analyse the impact of the project on access to irrigation water between beneficiaries at head, middle and tail-end of the project; iii) evaluate the impact of the project on cropped area under irrigation activities of beneficiaries and non-beneficiaries in the study area; vi) determine the impact of the project on poverty status of beneficiaries and non-beneficiaries in the study area; v) assess the determinants of povery among beneficiaries and non-beneficiaries; and vii) identify constraints faced by beneficiaries and non-beneficiaries in the implementation of the project.

This study focused on Stage I of the HVIP two stages. The reasons for the selection of Stage I were: a) 50% activities of Stage I have been completed and it was imperative to study the socio-economic impact of such project after its full fruition and impact, b) Stage I was totally irrigated by the HVIP system and the area under command of Stage I was a socio-cultural enclave and its value system was embedded in the history of the people. Therefore, the radical changes in socio-economic indicators were measurable.

Moreover, the following hypotheses were tested in the research work: There was no significant effect of HVIP on access to irrigation water by beneficiaries at head, middle and tail-ends areas of the project; There was no significant effect of HVIP on cropped area under irrigation activities of beneficiaries in the study area; There was no significant effect of HVIP on poverty reduction among beneficiaries in the study area. The theoretical framework underpinning this study was the Social Change Theory and the Perspectives on Social Impact Assessment.

At the chosen research location of Jigawa State, Hadejia emirate has eight Local Government Areas (LGAs)—Auyo, Birniwa, Hadejia, Kaffin-Hausa, Mallam Madori, Kaugama, Kirikasama, and Guri. Auyo and Kirikasama LGAs were selected for the field study, which represented the first stratum. These were specifically chosen because while Auyo LGA has the HVIP developed irrigable areas, (known as the "sectors") Kirikasama LGA has 80 percent of dry-season irrigation activities in Hadejia emirate as pointed out by Omilola (2009). The second stratum of the sampling technique took place at the village level. A quick tour of all the villages in Auyo and Kirikasama LGAs was made in order to obtain a general picture of the prevailing situation with regards to the use of irrigation technologies.

Sixteen villages were selected for the study; eight was from Auyo LGA comprising: Adaha, Auyo, Ayama, Gamsarka, Ganuwar Kuka, Gatafa, Marina, and Yamidi. Similarly, eight private farms located in Kirikasama LGA (along the tributaries of rivers Hadejia and Kafin-Hausa) consisted of: Fandum, Ganji, Jiyan, Kubayo, Malinta, Matarar Galadima, Tage, and Turabu were selected as Non-project areas (non-sectors). The sixteen villages were purposively selected to ensure that they were representative of other villages in the same general location.

The third phase of the fieldwork component was the main fieldwork survey in which in-depth collection of data took place in 2014. In this study, proportionate random sampling of beneficiaries (207) and non-beneficiaries (146) was conducted because of the multi-stage random sampling approach adopted, which required larger samples than single-stage design. Three hundred and fifty-three (353) beneficiaries and non-beneficiaries were interviewed as the sample sizes of the study.

However, the results of t-test on access to irrigation water showed that the *t*-calculated on access to irrigation water: irrigation water availability: t = 1.571, 1.518, and 1.448; p = 0.399, 0.319 and 0.437; equality of water distribution: t = 1.554 1.513 1.554, p = 0.4, 0.319 and 0.428; satisfaction: 1.426 1.364, and 1.431, p = 0.408, 0.338 and 0.438; and water charges t = 2.193, 1.909 and 2.233 were less than the t critical (1.96) at 0.05% level of significance. Therefore, the null hypothesis on no significant impact of HVIP on access to irrigation water on beneficiaries at head, middle and tail-end areas of the Project was rejected. So, HVIP had impacted on access to irrigation water in the command area.

The mean cropped area under irrigation activities of beneficiaries (M = 50.74, SD = 121.68, N = 19) and that of non-beneficiaries (M = 34, SD = 59.879, N = 19), t (18) = 1.817, p = 0.043 was less than the t critical (1.96) at 0.05% level of significance. Also, the mean cropped area of beneficiaries between head (M = 27.89, SD = 65.087, N = 18), t = 1.868, p = 0.039, middle (M = 24.26, SD = 58.96, N = 18), t (18) = 1.794, p = 0.045, tail-end (M = 16.89, SD = 54.38, N = 18) at, t (18) = 1.600, p = 0.064 were less than the t critical (1.96) at 0.05% level of significance. Consequently, the null hypothesis on no significant impact of HVIP on cropped area under irrigation activities of beneficiaries in the study area was rejected. As such, HVIP had impacted on irrigation cropped area between beneficiaries and non-beneficiaries and within the command area of the project.

HVIP had no significant impact on poverty reduction among beneficiaries and non-beneficiaries in the study area. The mean employment opportunities of beneficiaries (M = 17.35, SD = 16.83, N = 19), t (18) = 4.583, p = 0.000, was greater than the t critical (1.96) at 0.05% level of significance. Results of the calculated crop productivity $F_{(1,410)}$ value

(284.2), the F value needed to exceed (F critical = 3.86) and net farm income $F_{(1, 410)}$ value (726.3), the F value needed to exceed (F critical = 3.86) in order to have a significant difference between beneficiaries' and non-beneficiaries' crop productivity and net farm income were higher in both cases.

The poverty measures indicated in Table 5.15 show that 17% of beneficiaries sampled were classified to be living below the poverty line of ₦12, 489.00 while 36% of non-beneficiaries correspondingly lived below the poverty line of ₦ 9,961.20. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for non-beneficiaries respectively. This meant that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them up to the poverty line. Equally, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries.

The result in Table 5.16 further shows that at 5% level of significance, the beneficiaries' probability of poverty was determined by age, t-ratio = 2.29, p = 0.023 level of education, *t*-ratio = -3.76, *P* = 0.151, non-farm income, *t*-ratio = -0.76, *P* = 0.444, farm size, *t*-ratio = -1.5, *P* = 0.135 and credit, *t*-ratio = -1.74, *P* = 0.084. However, the non-beneficiaries'probability of poverty was determined by age, t-ratio = 1.54, p = 0.125, non-farm income, *t*-ratio = -0.81, *P* = 0.419, extension visit, *t*-ratio = -0.91, *P* = 0.362, subsidy, t = 0.552 and cost of labourt *t*-ratio = -0.74, *P* = 0.856. Consequently, the null hypothesis on no significant effect of HVIP on poverty reduction among beneficiaries in the study area was rejected. As such, HVIP had impacted on poverty reduction among beneficiaries in the study area.

Risk and vulnerability analysis among poor rural households according to some authors is important to an understanding of the social relations and decision-making processes that underlie households' livelihood diversification strategies (Ellis, 2000). Therefore, crop production and livestock rearing are the main livelihood sources for rural farm households in the study area. Some respondents engaged in off-farm income generating activities. Impact of shocks on household livelihood outcomes increasing food production, enhancing access to quality health care and education constituted the major poverty concerns of the farm households in the study area. To increase food production, the farm households specialised and diversified both crop and livelihoods in the project and non-project areas studied as strategies for achieving their objectives. Among the list of constraints that posed threats beneficiaries perceived environmental risks such as: siltation (20%); waterlogging (18%); water pollution (15%); soil erosion (11%); flooding (4%); and high humidity (6%) as constraints to their irrigation activities.

However, (22%) of non-beneficiaries pointed flooding as the only major environmental constraint they faced in their irrigation activities. Equally, results indicated that health related risks covered: typhoid (31%); cholera (29%); malaria (22%); schistosomiasis (16%); ringworm (1.5%); and nematodes (0.5%) mentioned as constraints faced by project beneficiaries. Similarly, crop-related risks that centered on Quela birds (18%); weed infestation and plant diseases such as blast and rust (21%); rodents (10%) and insect pest (9%) were faced by project beneficiaries. In contrast, (8%); (22%) and (1%) of non-beneficiaries mentioned quela birds, weed and disease infestation as constraints in their irrigation farming activities.

In the same way, institutional risks such as: poor water management (48%); construction works (27%); excessive fertilizer (15%) and agrochemicals use (10%) were cited as causes of the general constraints faced by the project beneficiaries. None of non-beneficiaries mentioned these as constraints. Results further, showed that physical risks involved high cost of farm inputs (100%); delay in the distribution of farm inputs (75%); low level of western literacy; high cost of land; and poor infrastructure scored (31%) each; loss of farm land (29%); poor working environment (6%); poor service (4%) reported by the project beneficiaries. But, the major constraints faced by non-beneficiaries were: fuel (14%); fertilizer (12%); tractor hire (8%); credit (6%); produce price (3%) and seeds (2%) in that order.

On the other hand, one of the coping strategies equally used by beneficiaries and non-beneficiaries against production risks was ensuring access to water lifting facilities such as pumping machines (4% and 25% Table 5.17). Besides, varying the allocation of land to major crops was another coping strategy employed by both beneficiaries and non-beneficiaries. Usually, both specialised and diversified their crops and produced those that were more marketable and engaged in open marketing as a strategy for strengthening their bargaining power (maize 24% and 43%; rice 76% and 48%; of beneficiaries and non-beneficiaries: wheat 4%; onion and tomato 0.3%; others 5%). Further, almost all the studied respondents owned at least one motorcycle, which was an important means of transport. Radios, video, VCD and satellite were important sources of information and entertainment for a majority of the sampled households. There was as well, minimal access to credit among the farm households. The farm families were either ignorant of the availability of credit facilities or made no effort to search for such facilities.

On household consumption and cash requirements given the wide range of wants respondents must make rational decisions on the component and volume of expenditure. The revenue from the sales of harvested irrigated produce was spent on for instance, feeding (36% and 44%), education (36% and 44%), health care (36% and 33%), clothing (36% and 41%), and equipment, automobile and other domestic needs. To ensure access to irrigation water beneficiaries used conjunctive sources of surface and underground water in irrigating their crops. Basically, both beneficiaries and non-beneficiaries were using surface and groundwater to improve the overall availability and reliability of irrigation water in their farming operations using motorised pumps (100%). Both might share common purposes for using two sources in combination such as managing diminishing surface water supplies, convenience, and economics, using water reasonably and beneficially.

On their opinion as to whether, water extraction should be regulated 90 percent of beneficiaries said that it should be open while 10 percent opined that it should be regulated by government. But, 53 percent of non-beneficiaries indicated that it should be open whereas 47 percent agreed that it should be regulated by government. Moreover, 99 percent of beneficiaries preferred water rights to other forms of water regimes while 100 percent of non-beneficiaries preferred other forms perhaps, community forms of water rights.

In summary, the results of this study revealed that impact of the variables measured could be attributed to the Hadejia Valley Irrigation Project which might have been restricted to the project beneficiaries and the Jigawa state and other irrigation systems were non-existent in the area. Generally, the findings rejected the hypotheses that there were no significant impacts on the indices. It also, supported the development and social impact assessment perspectives which stated that whenever project beneficiaries were properly motivated through the provision of functional services, the tendencies for increased productivity, income and poverty reduction were assured.

Therefore, the project studied has had positive impact on the beneficiaries as indicated by the differences in crop productivity, income from irrigated farming activities and poverty reduction among beneficiaries.

6.2 Conclusion

Irrigation interventions can transform the lives of its beneficiaries and their communities through a number of pathways. All three dimensions of irrigation—availability, access, and use—have an impact on how farmers are affected by irrigation interventions and thus on the success of irrigation development. Availability of water for irrigation is essential, as irrigation technologies would only be sustainable if there is a sustainable source of water. In this study, the chief effects were via irrigation cropped area, increased crop productivity, farm income and employment opportunities and hence, poverty reduction among beneficiaries.

The first objective of the study was to describe the socio-economic and institutional characteristics of the respondents. These were: age, household size, level of formal education, non-farm income, irrigation farming experience, farm size, reaches, extension visit, access to credit, subsidy on inputs, and membership of water users' association. A part from non-farm income and cost of hired labour, all other variables of the beneficiaries were higher than that of non-beneficiaries. The implications of these findings on one hand were that greater household size of beneficiaries might have contributed to supply of farm labour which reduced the cost of hired labour. On the other hand, beneficiaries participated less in off-farm employment that might have reduced income from other activities a part from irrigation.

Objective two of the study was to analyse the impact of the project on access to irrigation water between beneficiaries at head, middle and tail-ends of the project. The results of this study further, pointed that the null hypotheses on quality of irrigation service parameters: availability of distribution, equity, level of satisfaction of irrigation water supply, payment of water charges, were rejected at the head, middle and tail-end villages at 0.05% level of significance. Therefore, HVIP had impacted on access to irrigation water in the command area. This meant that public irrigation provides a better opportunity to exploit water resources in irrigation than private individual irrigation schemes.

The third objective of the study was to evaluate the impact of the project on cropped area under irrigation activities of beneficiaries and non-beneficiaries in the study area. The results suggested that beneficiaries had a mean farm size of 3.2 hectares while non-beneficiaries had a mean farm size of 2.1 hectares. Consequently, the null hypothesis on no significant impact of HVIP on cropped area under irrigation activities of beneficiaries in the study area was rejected at 0.05% level of significance. As such, HVIP had impacted on irrigation cropped area under irrigation activities of beneficiaries. Impliedly, these findings suggested that when irrigation structures are constructed beneficiaries could cultivate more land compared to where it is not.

Objective four of this study was to determine the impact of the project on the poverty status of beneficiaries and non-beneficiaries in the study area. The poverty measures indicated in Table 5.15 show that 17% of beneficiaries were classified to be living below the poverty line of ₦12, 489.00 while 36% of non-beneficiaries correspondingly lived below the poverty line of ₦ 9,961.20. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for non-beneficiaries respectively. This meant that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them up to the poverty line. Equally, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries. The inferences of these study revealed that lack of basic necessities like food, shelter, better education, health were more in non-project than project area as suggested by the percentage of those living below the poverty lines and the poorest among the respondents..

The fifth objective of this study was to assess the determinants of poverty among beneficiaries and non-beneficiaries. The result in Table 5.16 further shows that at 5% level of significance, the beneficiaries' probability of poverty was determined by age, *t*-ratio = 2.29, p = 0.023, level of education, *t*-ratio = -3.67, *P* = 0.151, non-farm income, *t*-ratio = -0.76, *P* = 0.444, farm size, *t*-ratio = -1.5, *P* = 0.135 and credit, *t*-ratio = -1.74, *P* = 0.084. However, the non-beneficiaries' probability of poverty was determined by age, *t*-ratio = 1.54, p = 0.125, non-farm income, *t*-ratio = -0.81, *P* = 0.419, extension visit, *t*-ratio = -0.91, *P* = 0.362, subsidy, t = 0.89, p = 0.461 and cost of labourt *t*-ratio = -0.74, *P* = 0.856. Consequently, the null hypothesis on no significant impact of HVIP on poverty reduction among beneficiaries in the study area was rejected. As such, HVIP had impacted on poverty reduction among beneficiaries in the study area. The results impliedly, meant that very few factors determined poverty in the case of beneficiaries when compared with non-beneficiaries.

The sixth objective of this study was to identify constraints faced by beneficiaries and non-beneficiaries in the implementation of the project. In spite of the contribution of the project to improve rural livelihoods through the provision of rural employment (agricultural productivity and income earning opportunities) it was found that farmers in the project and non-project area faced some constraints. Environmental, health, physical and institutional constraints were faced by the project beneficiaries. Therefore, the project studied has had positive as well as negative impact on the beneficiaries as indicated by the differences in access to irrigation water, cropped area under irrigation activities, employment opportunities, crop productivity, income from irrigated farming activities and poverty reduction among beneficiaries and non-beneficiaries in the area studied. It also, supported the development and social impact assessment perspectives which stated that whenever project beneficiaries were properly motivated through the provision of functional services, the tendencies for increased productivity, income and poverty reduction among beneficiaries were assured. Therefore, the implications may be some conflicting interests between farmers, government and the environment which distort planned systems and the impact on farmers or the community was negative. It is argued that it is not sufficient to assume direct beneficial impact of all irrigation projects.

From the results of the t-and F-tests and Foster-Greer-Thorbecke (1984), which is also called the P-alpha class of poverty measures, it was concluded that Hadejia Valley Irrigation Project had impacted on crop productivity and poverty reduction among its beneficiaries. These findings were also consistent with Musa (2004) who reported that participation in the Dan-Nakola Irrigation Project significantly improved the living conditions of the beneficiaries through increased crop output and income. It could also, be concluded that the Hadejia Valley Irrigation Project as a development and social impact intervention Project had achieved the goal for its establishment.

6.3 Recommendations

i. Government should encourage productivity and access in both farm and non-farm occupations. At the same time income sources diversification and labor market training should be encouraged.

ii. The project authority should have a uniform water fee collection policy especially at the end of the cropping seasons when Beneficiaries might have harvested their crops.

iii. Given that poverty increases with the number of household members (or family size), government should intensify family planning services efforts and activities to improve knowledge, acceptance and practice of family planning.

iv. Measures should be taken by the Project authority to address inadequate access to extension.

v. The project beneficiaries should form farmers' cooperatives and other farmers' organisations for the purpose of knowledge transfer, input, output, marketing and distribution, savings mobilisation, and farm credit sourcing and supply,

vi. Measures should be taken by the project authority to promote cost-saving and appropriate technologies that would release labour from irrigation to reduce the cost incurred in production.

6.4 Contributions to Knowledge

The study has come up with followings:

i. Non-beneficiaries' non-farm income and cost of hired labour (₦ 237,047=00 and ₦ 137,797) were greater than that of beneficiaries (₦ 55, 709=00 and ₦ 33,641=00.

ii. Majority of the respondents in this study were small-scale beneficiaries and non-beneficiaries (31% and 70%).

iii. Project beneficiaries were located at head (48%), middle (30%) tail-end (22%) reaches of the project area respectively.

iv. Maize (24%) and rice (76%) were the dominant crops grown by the project beneficiaries whereas apart from maize (43%) and rice (48%), non-beneficiaries cultivated other crops in the following order: onion and tomato (0.3% each) wheat (4%), other crops (5%).

v. Crop productivity per hectare was that 28% of beneficiaries realised 3000 and kilogrammes per hectare compared to non-beneficiaries with 13%.

vi. The costs incurred in naira per hectare by beneficiaries and non-beneficiaries were ₦ 71, 525 = 00 and ₦ 55, 387 = 00.

vii. Farm income realised by beneficiaries (₦ 697,852=00) was higher than that of non-beneficiaries (₦ 403,092=00).

viii. Beneficiaries living below the poverty line of ₦12, 489.00 were (17%) while 36% of non-beneficiaries correspondingly lived below the poverty line of ₦ 9,961.20.

ix. The poverty head count, depth and severity were 0.72, 0.12 and 0.088 for beneficiaries and 0.8, 0.28 and 0.23 for non-beneficiaries respectively. This meant that 72% and 80% of beneficiaries and non-beneficiaries were above the poverty line respectively. But, 12% and 28% of beneficiaries' and non-beneficiaries' expenditure were required to bring them up to the poverty line. Equally, the poorest accounted for 9% and 28% of the beneficiaries and non-beneficiaries.

x. Environmental constraints faced by beneficiaries that hampered crop production were**:** Siltation 20%; waterlogging 18%: water pollution 15%; erosion 11%; flooding 4%; high humidity 6%; 11% and 15% soil erosion and pollution. However, (22%) of non-beneficiaries pointed flooding as the major constraint they faced in their farming activities.

xi. Also, health constraints were: typhoid 31%; cholera 29%; malaria 22%; schistosomiasis 16%; ringworm 1.5%; and nematodes 0.5% faced by Project beneficiaries.

xii. Crop-related constraints faced by beneficiaries were: Quela birds 18%; weed infestation 21%; plant diseases such as blast and rust 21%; rodents 10%; and insect pests 9% but, non-beneficiaries indicated 18% quela birds; 22% weed infestation; and 1% plant diseases.

xiii. Physical constraints encountered by beneficiaries included: high cost of farm inputs 100%; delay in the distribution of farm inputs 75%; low level of western literacy; high cost of land; and poor infrastructure scored 31% each; loss of farm land 29%; poor working environment 6%; poor irrigation service 4% were reported by Project beneficiaries. But, the major constraints faced by non-beneficiaries were: fuel (14%); fertilizer (12%); tractor hire (8%); credit (6%); produce price (3%) and seeds (2%).

xiv. Institutional constraints faced by beneficiaries were: poor water management (48%); construction works (10%); excessive fertilizer and agrochemicals use (21% each).

REFERENCES

Adegeye, A. T., and Dittoh, J.S. (1985). *Essentials of Agricultural Economics*. Impact Publishing Nigeria Limited.

Akinyele, I. O. (2009). Ensuring Food and Nutrition Security in Rural Nigeria: An Assessment of the Challenges, Information Needs and Analytical Capacity. Nigeria Strategy Support Program (NSSP) Background Paper No. NSSP 007: November.

Alayande, B. A., and Alayande, O. (2004). *A Quantitative and Qualitative Assessment of Vulnerability to Poverty in Nigeria.* A Paper submitted for presentation of CSAE conference on poverty reduction, growth and human development in Africa, March, 2004. (Accessed 16-05- 2012).

Anderson, P., and Shimokawa, S. (2006). *Rural Infrastructure and Agricultural Development.* Paper presented at the Annual Bank Conference on Development Economics. Tokyo, Japan, May 29–30, 2006.

Anyanwu, J. C. (1997). "Poverty In Nigeria: Concepts, Measurement and Determinants", in Nigerian Economic Society (NES), Poverty Alleviation In Nigeria, Proceedings of the 38th Annual Conference, NES, Ibadan, 93 – 120.

Archer, M. (1995). *Realist Social Theory: The Morphogenetic Approach.* Cambridge University Press, Cambridge.

Barry, B. (2002). Development of Urban and Peri-urban Irrigation in Africa In: Sally, H., and Abernethy, C. L. (Eds.) *Private Irrigation in Sub–Saharan Africa,*Colombo, Sri Lanka: International Water Management Institute (IWMI), Food and Agricultural Organization (FAO) of the United Nations and Technical Center for Agricultural and Rural Cooperation (CTA): Pp 57-63.

Bhattarai, M., and Narayanamoorthy, A. (2004). Impact of Irrigation on Agricultural Growth and Poverty Alleviation: Macro-level Analysis in India,*Research Report,*12. IWMI, Colombo. Sri Lanka.

Bhattarai, M., Sakthivadivel, R., and Hussain, I. (2002). Irrigation Impacts on Income Inequality and Poverty Alleviation: Policy Issues and Options for Improved Management of Irrigation Systems, *Working Paper,* 39. Colombo, Sri Lanka: International Water Management Institute.

Burdge, R. J., and Vancla, F. (1995). Social Impact Assessment: A Contribution to the State of the Art Series In: *Environmental and Social ImpactAssessment.* John Wiley and Sons, United Kingdom.

Burke, J., Moench, J., and Marcus, H. (2000). Goundwater and Society: Resources, Tensions and Opportunities. Themes in Groundwater Management for the Twenty-First Century.

Butler, S. B. (2009). Improving Land Policy for Private Sector Development in Nigeria: Lessons and Challenges Ahead. *Paper presented at the World Bank Conference on Land Governance in Support of the MDGs,* Washington, D.C.9–10 March.

Chambers (1994) page 10 of the downloaded A material

Chang, H., and Boisvert, R. N. (2009).The Conservation Reserve Program, Off-farm Work, and Farm Household Technical Efficiencies,*Working Paper,* 2009-33. Ithaca, New York, USA: Cornell University, Department of Applied Economics and Management.

Chitamber, J.B. (1973). *Introduction to Rural Sociology*. New York, Willey Eastern Limited. p102.

Dadari, S.A., (1988). Chemical Weed Control in Irrigated Wheat. Cropping Scheme Meeting. Cereals Research Programme, IAR, A.B.U. Zaria. p65.

David, R. (2005). *Experimental Bioscience*. Introductory Laboratory Bioscience Textbook. Rice University. p2.

Department for International Development (2004). Rural Urban Development: Case Study- Nigeria.Oxford Policy Management, June 2004: p. 22.

Dercon, S. (2000). Economic Reform, Poverty Reduction and ProgrammeAid. Paper Presented for the SIDA Conference on Aid and Development, Stockholm, 20-21 January.

de Smith, M J. (2012). *Statistical Analysis Handbook*. www.statsref.com (Accessed 12-08-2-15).

Dorward, A. R., Kydd, J. G. Morrison, J. A., and Urey, I. (2004). A Policy Agenda for Pro-poor Agricultural Growth.*World Development,* 32, 1: 73-89.

Dorward, A. R., Chirwa, E., Boughton, D.,and Kelly, V. A. (2007). Evaluation of the 2006/7 Agricultural Input Supply Programme(Malawi Interim Report). Imperial College London, March.

Enplan Group (2004). Review of the Public Irrigation Sector in Nigeria. (Draft Status Report Rev. 1 of Project UTF/046/NIR/UTF). Abuja, Nigeria.

Ekong, E.E. (2003). *An Introduction to Rural Sociology*. Uyo, Nigeria. Dove Educational: Pp1-131.

Ellis, F. (2000) *Rural Livelihoods and Diversity in Developing Countries*. Oxford, Oxford University Press.

Fan, S., Hazell, P., and Throat, S. (1999). Linkages between Government Spending, Growth and Poverty in Rural India.Washington D.C., International Food PolicyResearch Institute.

Faruqui, N.I., Niang, S., and Redwood, M. (2004). Untreated Wastewater Use in Market Gardens: A Case Study of Dakar, Senegal In: Scott, C., Faruqui, N.I., Raschid, L. (Eds.), *Wastewater Usein Irrigated Agriculture: Confronting the Livelihood and Environmental Realities.* Wallingford: IWMI-IDRC-CABI: Pp113-125.

Federal Office of Statistics (2005). Poverty Profile of Nigeria. Federal Office of Statistics Publication (FOS), Lagos, Nigeria.

Federal Office of Statistics (1999). Poverty and agricultural sector in Nigeria. Federal Office of Statistics Publication (FOS), Lagos, Nigeria.

Food and Agricultural Organization (FAO) (2003). A perspective on water control in Southern Africa support to regional investment initiatives. *Land and Water Discussion Paper*, 1. Rome, Italy.

Foster, J., Greer, J., and Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. *Econometrica*, 52(3): 761-766.

Frederick, K.D. (1992). Managing Water for Economic, Environment and Human Health In: Darmstadter, J. (Ed.) *Global Development and Environmental Perspectives on Sustainability: Resources for the Future*. Washington D.C.: 62-68.

Gertler, P.J., Martinez, S., Premand, P., Rawlings, L. B., and Christel, M. J. (2010). Impact Evaluation in Practice: Ancillary Material.The World Bank, Washington D.C.*www.worldbanj.org/ieinpractice*. (Accessed 6-01-2013).

Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration.* Polity Press, Cambridge, United Kingdom.

Goes, B.J.M., Zabudun, A.N. (1996). Water Management Issues in the Hadejia River System.Paper presented at the 9th National Conference Associstion of Hydrologists, Sokoto 17-21, November.

Goldface-Irokalibe, I. J. (2008).Towards an Effective Legal and Institutional Framework for Integrated Water Resources. Forum of Federation, Global Network of Forum of Federalism, Ahmadu Bello University, Zaria, Nigeria.

Grainger, A. (1990). *The Threatening Desert: Controlling Desertification*. London, United Kingdom. Earthscan Publications.

Graph, Pad Prism (1999). Analysing Data with Graphpad Prism. Graph Pad Software, Inc: 1-5.

Gregory, I. (2006). The Role of Input Vouchers in Pro-poor Growth. Background paper prepared for the African fertilizer summit, Abuja, Nigeria, 9-13June.

Hadejia Jama'are River Basin Development Authority (HJRBDA) (2012). Hadejia Valley Project, Phase I, Stage I (7,013ha. of land including all head works and field structures). Unpublished Document. Hotoro, Kano.

Handidu, J. A. *(*1990). National Growth, Water Demand and Supply Strategies in Nigeria in the 1960s. *Journal of the Nigerian Association of Hydrogeologists (NAH),* 2, 1.

Hussain, I., Marikar, F., and Thrikawala, S. (2002). Impact of Irrigation Infrastructure Development on Poverty Aalleviation in Sri Lanka and Pakistan.Colombo, Sri Lanka: International Water Management Institute (IWMI).

Hussain, I., and Hanjra, S. (2004). Pro–poor Intervention Strategies in Irrigated Agriculture in India. Poverty in Irrigated Agriculture: Issues and Options. *International Water Management Institute (IWMI),* 53:1-15.

Ibabu, S.C., Nwas, B.T., and Traxer, G.J. (1996). Irrigation Development and Degradation in Developing Countries: A Dynamic Model of Investment Decisions and Policy Options. *IFPRI Paper,* 337: 1-15.

Idiong, I. C., Agom, D. I., and Ohen, S. B. (2006). Comparative Analysis of Technical Efficiency in Swamp and Upland Rice Production Systems in Cross Rivers State, Nigeria In: Adepoju, S. O. and Okuneye, P. B. (Eds). *Technology and Agricultural Development in Nigeria.* PP 425 – 432. Proceedings of the 20th Annual National Conference of Farm Management Association of Nigeria,Federal College of Forestry Jos, Plateau State, Nigeria: 18–21 September.

International Fund for Agricultural Development (IFAD)(2001). Rural Poverty Report 2001: The Challenge of Ending Rural Poverty. Oxford: University Press Published forthe International Fund for Agricultural Development.

International Fund for Agricultural Development (IFAD) (2010).Enabling poor rural people to overcome poverty in Nigeria. www.ifad.org (Accessed 8-10-2012)

Jake, D. J. (2011). Agricultural Sustainability of Smallholder Floodplain Agricultural Systems: A Case Study of Areas in North-Central Nigeria. Ph.D Dissertation Development Planning Unit/Bartlett Faculty of the Built Environment, University College, London.

Jelili, O. S., Victor, O. O., Omobowale, A. O., and Abayomi, S. O. (2011). The Structure and Determinants of Land-use Intensity among Food Crop Farmers in Southwestern Nigeria. *Journal of Agricultural Science,* 3, 1.www.ccsenet.org/jas. (Accessed 20-08-2014).

Joreskog, K.G. (2002). Censored Variables and Censored Regression.p15.

Kabre, A.T., and Zerbo, H. (2001). Annex 3-development et recherche sur I' Integration de l'irrigation et de l'aquaculture au Burkina Faso In: Moehl, J.F., Beemasts, I. C., Halwart, A., and Sagua, V.O. (Eds.). *Proposal for an African Network on Integrated Irrigation and Aquaculture.*Proceedings of a Workshop held in Accra. Rome. A Publication of FAO, Ghana, 20-21 September, 1996.

Karlsson, M. (2001). Opening Address In: Pleskovic, B. and N. Stern(Eds). AnnualWorld Bank Conference on Development Economics, 2000', 7-11.

Keiser, J., Caldas de Castro, M., Maltese, M. F., Bos, R., Tanner, M., Singer, B. H., and Utzinger, J. (2005). Effect of Irrigation and Large Dams on the Burden of Malaria on a Global and Regional Scale. *American Journal of Tropical Medicine and Hygiene,* 72, 4: 392–406.

Kesavachandran, C. N., Fareed, M., Pathak, M. K., Bihari, V., Mathur, N., and Srivastava, A. K. (2009). Adverse Health Effects of Pesticides in Agrarian Populations of Developing Countries. *Reviews of Environmental Contamination and Toxicology,* 200: 33–52.

Latif, M., and Pomee, M.S. (2003). Impacts of Institutional Reforms on Irrigated Agriculture in Pakistan. *Irrigation and Drainage Systems,* 17(3): 195-212.

Lawal, A.O., Yiljep, Y.D., Othman, M.K., Akpoko, J.G., and Murtala, G.B. (2007).The Level of Adoption of and Use of Irrigation and Drainage Technologies in Nigeria. 13th National Irrigation and Drainage Seminar: *Managing Irrigation Projects towards Achieving MDGs.* IARS/NEARLS, ABU, Zaria, Nigeria.11-13 June.

Lim, J.N.W., and Douglas, I. (1998). *Pacific Viewpoint: An Association Review of Bio-diversity and Environmental Conservation,* 39: 315-326.

Lipton, M., Sinha, S., and Blackman, R. (2002). Reconnecting Agricultural Technology to Human Development.*Journal of Human Development,* 3, 1: 123-152.

Lipton, M. (2007).Farm Water and Rural Poverty Reduction in Developing Asia. *Irrigation and Drainage*, 56: 127–146.

Long, N. and Van der Ploeg, J. D. (1989). Demythologizing Planned Intervention: An ActorPerspective. *Sociologia Ruralis,* 29(3-4): 226-249.

Mauritius Sugar Industry Research Institute (MSIRI) (1994). A Socio-economic Study of Small Sugarcane Planters in Mauritius (A Report on Survey carried-out in

Four Factory Areas By the MSIRI and the Farmers Service Corporation(MSIRI Occasional Report, 5). Tebaloi Mauritius, Printed by Reduit: P17.

McCartney, M.P. (2007). Decision Support Systems for Large dam Planning and Operation in Africa(*Working Paper, 119*). Colombo, Sri Lanka: International Water Management Institute. p47.

McDonald, J.F., and Moffit, R.A. (1980). The Uses of Tobit Analysis. *Review of Economics and Statistics*, 62 (2): 318–321.

Ministry of Agriculture and Natural Resources (MANR) (1975). Final Report Hadejia Valley Feasibility Study Kano State, Nigeria Overview, FMC International, S.A. April.

Mohammed, S., Sani, R.M., Idi, S., and Jidda, Y. (2009). Comparative Study of Rain-fed and Irrigation Methods of Rice Production in Dadinkowa, Gombe State, Nigeria In: Mohammed, I., Kyiogwom, U. B., Hassan, U.B. A., Ala, L., Singh, A. and Dogondaji, A. (Eds.). *Sustaining Agricultural Growth to Meet National Economic Development Goal.*Pp 304–308.Proceedings of the 23rd Annual National Conference of Farm Management Association of Nigeria Usmanu Danfodiyo University Sokoto, Sokoto State, Nigeria. 14 – 17 December.

Mollinga, P. P. (2003). On the Waterfront: Water Distribution, Technology and Agrarian Change on a South Indian Canal Irrigation System. *Wageningen University Water Resources Series,* Hyderabad, India: Orient Longman.

Moore, W. (1963). *An Introduction to the Sociology of Rural Development.* London, Tavistock Publishers: Pp 9-15.

Morardet, S., Seshok, J., Sally, H., and Meery, D. (2005). Review of Irrigation Planning and Implementation Process(Report to the African Development Bank). Pretoria, South Africa: Washington D.C. Published by International Water Management Institute: p10.

Muhammad, J., Usman, A., and Denita, C., (2003). Participatory Irrigation Management in Pakistan: Initial Results of a Pilot Project. *South Asian Water Studies (SAWAS),* 4, 1.

Murtala, N., Haruna, U., Abdurahman, S. and Gwaram, S. O. (2004). Costs and Returns Analysis of Poultry Eggs Marketing in Bauchi metropolis, Bauchi State, Nigeria.Paper presented at the 2004 Annual Conference of the Nigerian Association of Agricultural Economists. Held at Ahmadu Bello University Zaria, Kaduna State, Nigeria.

Musa, J. D. (2004). *Effects of Irrigation Practices on the Rural Life.* Lagos, Nigeria. Dobby Publishers: Pp 122-136.

Nambiro, E. (2008). Trends in Land Use and Agricultural Intensification in Akamega, Western Kenya Inaugural Dissertation. Rheinischen-Friedrich-Wilhelms-

Universität Keni (Nairobi): p8. http://hss.ulb.uni-bonn.de/diss_ (Accessed 10-07-2014).

Narayan, D., Chambers, R., Kaul Shah, M., and Petesch, P. (2000). Global Synthesis, Consultations with the Poor. Paper prepared for Global Synthesis Workshop. 22-23September, World Bank, Washington, D.C.

National Population Commission (NPC) (2007). The 2006 Population Census Official Gazette (Extraordinary), Volume 94, Number 24, May 15, Lagos.

New Partnershipn for African Development, (NEPAD) (2002). Comprehensive Africa Agriculture Development Programme (CAADP). Agricultural strategy document. Rome: FAO.

Nigeria, Federal Republic of, (1975). Third National Development Plan 1975-1980 (I and II), Federal Ministry of Economic Development, Lagos.

Obuobie, E., Keraita, B., Danso, G., Amoah, P., Cofie, O.O., Raschid-Sally, L., Drechsel, P. (2006). Irrigated Urban Vegetable Production in Ghana: Characteristics, Benefits and Risks. IWMI-RUAF CPWF, Accra, Ghana: International Water Management Institute. p150. http://www.cityfarmer.org/GhanaIrrigateVegis.html (Accessed 20-04-2013).

Ogundele, F. O., and Oruruwa, V. O. (2004). A Comparative Analysis of Technical Efficiency between Traditional and Improved Rice Variety Farmers in Nigeria. *African Journal of Economic Policy*, 11, 1: 91-108.

Ojei, B. (2000). Draft Management Plan for Marma Channel and Nguru lake Complex, Nigeria. In: Peter, T. (Ed.) *Wetland Management Planning. Five Years Case Studies from West Africa*.Netherlands: Wetlands International.

Omilola, B. (2009). Estimating the Impact of Agricultural Technology on Poverty Reduction in rural Nigeria, *IFPRI Discussion Paper, 00901.*

Omonona, B.T. (2001). Poverty and its Correlates among Rural Farming Households in Kogi State. Unpublished PhD Thesis, Department of Agricultural Economics, University of Ibadan, Nigeria.

Omonona, B.T. (2009). Knowledge Review of Poverty and Rural Development in Nigeria.Nigeria Strategic Support Program (NSSP)(Report No. NSSP, 003).

Owens, T., Hoddinott, J., and Kinsey, B. (2001). *The impact of agricultural extension on farm production in resettlement areas of Zimbabwe*(Working Paper Series, 2001-6).University of Oxford.Center for the Study of African Economies.

Pages, J. (1995). Technical Assistance to Water Management, Crop Production and Community Organisation in Hadejia Valley Irrigation Project, Nigeria(Mission Report submitted to French Embassy in Nigeria).

Perret, S.R. (2002). Water Policies and Smallholding Irrigation Schemes in South Africa: A History and New Institutional Challenges. *Water Policy,* 4: 283–300.

Pinstrup-Andersen, P., and Pandya-Lorch, R. (2001). Agricultural Growth is the Key to Poverty Alleviation in Low-income Developing Countries. In: Pinstrup-Andersen, R., and Pandya Lorch, R. (Eds.). *The Unfinished Agenda.* Washington D.C.: International Food Policy Research Institute: Pp 109-114.

Pudasaini, S. P. (1983). Effects of Education in Agriculture: Evidence from Nepal. *American Journal of Agricultural Economics,* 65:508-515.

Rowntree, B. S. (1901). Poverty: A Study of Town Life. England: Macmillian and Co., p 437.

Saginga, P.O., Adesina, A.A., Manyong, V.M., Otite, O., and Dashiell, K.E. (1999).*Social Impact of Soyabean in Nigeria's Southern Guinea Savannah*.The United States: Publication of International Institute for Tropical Agriculture and Mega-Communication Network.

Saboor, A., Maqsood, H., and Madiha, M., (2009). Impact of Micro-credit in Alleviating Poverty: An Insight from Rural Rawalpindi, *Pakistan Journal of Life Social Science,* 7 (1): 90-97.

Sharman, P.V., Staal, S., Delgado, C., and Singh, R.V. (2003). Policy, Technical and Environmental Determinants and Implication of Scaling-up of Milk Production in India(Annex iii Research Report of International Food Policy Research Institute (IFPRI)-FAO, Livestock Industrialization Project, Phase II). New Delhi, India. IFRRI: p62.

Sen, A. K. (1976). Poverty: An Ordinal Approach to Measurement. *Econometrica,* 44(2): 219-31.

Sen, A.K. (1999). Development as Freedom. Oxford University Press, New York.

Siemens, J., Huscheka, G., Siebe, C. and Kaupenjohanna, M. (2008).Concentrations and Mobilityof Human Pharmaceuticals in the World's Largest Wastewater Irrigation System, Mexico City-MezquitalValley.*Water Resources,* 42: 2124-2134.

Small, L., and Svendsen, M., (1992). A Framework for Assessing Irrigation Performance.*Working papers on Irrigation Performance* No 1, Washington: IFPRI.

StatTrek.com. (2015).Teach yourself statistics @ www.t-TEST/Hypothesis Test Paired Means files/Hypothesis Test Paired Means.htm (Accessed 20-11-2015).

Tobin, J. (1958). Estimation of Relationships for Limited Dependent Variable. *Econometrica,* 26 (1): 24–36.

Tollens, E. (2002). The Challenges of Poverty Reduction with Particular Reference to Rural Poverty and Agriculture in Sub-Saharan Africa. Katholieke Universiteit Leuven,Faculty of Agricultural and Applied Biological Sciences, Working Paper 2002/67, Belgium.

Umoh, G. S. (2006). Resource Use Efficiency in Urban Farming: An Application of Stochastic Frontier Production Function. *International Journal of Agriculture and Biology,* 8, 1: 38- 44.

Van Hofwegen, P., and Svendsen, M. (2000). A Vision for Water for Food and Rural Development.Document presented to the 2nd World Water Forum. *http://www.watervision. org.From http://www.eng. warwick.ac.uk/ircsa/pdf*> (Accessed 10 -04-2013).

Weisstein, E.W. (2006). Paired t-test from Mathworld: A Wolfram Web Resources. Pp 1-2.

Wielgosz, B., Mangheni, M., Tsegai, D., and Ringler, C. (2012). Malaria and Agriculture: A Global Review of the Literature with a Focus on the Application of Integrated Pest and Vector Management in East Africa and Uganda(*IFPRI Discussion Paper, 1232*). Washington, DC: International Food Policy Research Institute.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: MIT Press.

World Bank (1996). Nigeria: Poverty in the Midst of Plenty. The Challenge of Growth with Inclusion.World Bank Poverty Assessment. Population and Human Resources Division, West Africa Department, Africa Region. Report No. 14733 UNI. World Bank, Washington DC, USA.

World Bank (1990). World Development Report. Oxford University Press, New York.

World Bank (2000). World Development Report. Washington, DC.

World Bank (WB) (2001). *World Development Report.* The World Bank: Washington, D.C.

World Bank (WB) (2004). *Nigeria: Sustainable Management of Mining Resources*.http://web.worldbank.org/external/projects/main?pagePK=6431288 1&piPK=64302848&theSitePK=4 941&Projectid=P086716 (Accessed 30-08-2010).

World Bank (WB) (2007). *World Development Indicators.* Washington, D.C: World Bank.

World Bank (WB) (2008). Prospective Benefits from Cotton Subsidy Cuts and New Technologies.(*Special Report: Making Outreach a Development Priority,* October).http://www1.worldbank.org/devoutreach/article.asp?id=512 (Accessed 20-12-2013).

World Bank Report (2000/2001). World Faith Development Dialogue 1999: A Different Perspective on Poverty and Development.Comment on World Development Report2000/2001 London.

World Resources Institute (WRI), UNEP (United Nations Environment Program); UNDP (United Nations Development Programme) (1993). World Resources 1992-93.

Wyss, H. (1991). Prospects for Irrigation Development in sub-Saharan Africa In: Barghouti, S., Le Moigne, G., (Eds.) *Irrigation in sub-Saharan Africa* (Bank Technical Paper, 123).World Bank, Washington, DC. Pp. 1-4.

Xie, M., Kuffner, U., Le Moigne, G. (1993).Using Water Efficiently(World Bank Technical Paper, 205).Washington, D.C. World Bank.

Yahaya, M. K. (2002). Development and Challenges of Bakolori irrigation Project in Sokoto State, Nigeria. *Nordic Journal of African Studies*, 11(3): 411-430.

Yunusa, M.B. (1999). Not Farms Alone: A Study of Rural Livelihoods in the Middle Belt of Nigeria. ASC Working Paper No. 38. African Studies Centre, Leiden, The Netherlands/Center for Research and Documentation (CRD), Kano, Nigeria.

APPENDIX I

IMPACT OF HADEJIA VALLEY IRRIGATION PROJECT (HVIP) ON CROP PRODUCTIVITY AND POVERTY REDUCTION IN JIGAWA STATE, NIGERIA.

Farmers' Questionnaire: Project beneficiary ( ) Non-project beneficiary ( )

Please, kindly answer the following questions as appropriate. All information provided would be treated confidentially.

SECTION A: Background Information

1. Name of farmer ___________________________Village____________________

2. Local Government Area ____

SECTION B: Socio-Economic Characteristics of Respondents

3. Age of farmer: ______________________ yrs

4. Marital status: a. Single [ ] b. Married [ ] Sex Male [ ] Female [ ]

5. Household size:

a. No of wives___________

b. No of children: Male_______ Female_____________

c. No of dependents: Male _______Female___________

d. Children under 18years _____________________________________

e. Others (specify) ____

6. Educational qualification:

a. No formal education Yes [ ] No [ ]

b. Primary education ……………….. ….yrs

c. Secondary …………………………….....yrs

d. Tertiary education ……………………yrs

e. Islamiyya …………………………….....yrs

f. Others (specify) ……………………… yrs

7. What was your major occupation?

a. Farming [ ]

b. Craftwork [ ]

c. Civil servant [ ]

d. Trading [ ]

e. Others (specify) ________________________

9. Please, estimate the money realised from the major occupation ________________ ₦

10. How long have you been living in this village? ___________________________ yrs

11. Were you in: the Project area [ ] non-Project area? [ ]

12. How long have you been farming? _____________________________________ yrs

13. How many hectares of land did you cultivate? ______________________ hectares

14. What was the tenancy status of plot (s) you cultivated?

a. Inheritance	[ ]	e. Purchase	[ ]
b. Government allocation	[ ]	f. Gift	[ ]
c. Lease	[ ]	g. Rent	[ ]
d. Loan	[ ]	h. Share cropping	[ ]

15. Did you receive visits from extension officials? Yes [ ] No [ ]

16. If yes; how often did you receive visits from the extension agents in a year?_____________ times

17. Were you satisfied with the visits? Yes [ ] No [ ]

18. If yes, give reasons ____

____

19. If no give reasons ____

____

20. Were you a member of any farmer organization? Yes [ ] No [ ]

21. If yes, how many associations did you belonged to?_____________________________

22. How long have you been a member of water users' associations? __________yrs

23. If yes, indicate your involvement in the activities of the organization?

Activities	Regularly	Occasionally	Rarely
a. Meetings			
b. Credit disbursement			
c. Demonstrations			
d. Trade fair/show			
e. Tours/excursion			
f. Trainings			
g. Fertilizer distribution			
h. Others (specify)			

24. What benefits did you derive from these organizations?

a. Information awareness [ ]

b. Easy access to financial assistance [ ]

c. Provision of goods and services at reduced cost [ ]

d. Easy access to farm labour [ ]

e. Others (specify) ________________________________

25. Have you obtained any credit in the past three years? Yes [ ] No [ ]

26. If yes, what were your sources of credit?

a. Commercial banks [ ]

b. Cooperative Societies [ ]

c. Friends and relatives [ ]

d. Money lenders [ ]

e. ADP [ ]

f. Micro finance [ ]

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

27. In what ways did you obtain services for your farm activities?____________________

28. What was the total amount received as credit for your farm activities? ₦ _________

29. What was the total amount received as subsidies for your farm activities?

₦ ___________________

30. What were the sources of labour for your farm activities?

a. Family labour [ ]

b. Hired labour [ ]

c. Cooperative labour [ ]

d. All of the above [ ]

e. Others (specify)____

31. How much did you spend in hiring labour in 2014? ₦ _____________________

SECTION C: Access to Irrigation Water

32. How long have you been practicing irrigation farming? _______________ yrs

33. How far was your irrigation farm from your residence?_________________kms

34. What system of irrigation did you practice?

a. Surface irrigation [ ]

b. Underground irrigation [ ]

35. If surface irrigation, what was the location (s) of the farm you cultivated?

a. Head - reach [ ]

b. Middle -reach [ ]

c. Tail – reach [ ]

36. How much of your land was irrigated by water from the dam? _________ hectares

a. All …………………………..hectares

b. Half………………………….hectares

c. A little plot………………….hectares

37. Are you satisfied with irrigation water distribution in the Project? Yes [ ] No [ ]

38. How frequent could you make use of water for irrigation during the cropping season?

a. Very frequent [ ] b. Frequent [ ] c. Not frequent [ ] d. Never [ ]

39. Irrigation water is distributed fairly to farmers in the Project area?

Agree [ ] Disagree [ ]

40. Did you make payment for water charges in irrigating your plot(s)? Yes [ ] No [ ]

41. Payment of water charges should be paid at?

a. At the beginning [ ] b. At the middle [ ] c. At the end [ ]

42. Do you agree or disagree with the above?

a. Agree [ ] b. Disagree [ ]

42. How much per season? ₦………………

43. How would you assess the payment of water charges?

b. Acceptable [ ] b. Expensive [ ]

42. Irrigation water is available throughout the cropping season in the Project?

a. Available [ ] b. Not available [ ]

43. Was water distribution equal for all farmers in your area?

a. Equal [ ] b. Fairly equal [ ] c. Not equal [ ]

44. Do you agree that there is equality in water distribution in the Project?

a. Agree [ ] b. Disagree [ ]

45. Which methods did you use in lifting water to irrigate your farm?

a. Shadouf [ ]

b. Treadle pump [ ]

c. Motorized pump [ ]

d. Others (Specify)……………………………………………..

46. If you used motorised pump to irrigate your farm, how did you obtain it?

a. Open market [ ]

b. Government [ ]

c. Hire [ ]

d. Borrow [ ]

e. Other (Specify)……………………………………………….

47. Who taught you to operate the motorized pump?

a. Government officials [ ]

b. Pump sellers [ ]

c. Local mechanics [ ]

d. Other farmer [ ]

48. Was access to groundwater?

a. Open [ ]

b. Regulated by government [ ]

c. Regulated by community [ ]

d. Others (Specify)…………………………………………………

49. Which of the following problems did you faced in lifting water for irrigation?

a. Drying up of wells [ ]

b. Declining water table [ ]

c. Declining water quality [ ]

d. Land subsidence [ ]

e. Rising cost of operations [ ]

50. Please tick in the table below your appropriate answers:

a. RA: Readily available	a. RA: Readily Accessible
b. FA: Fairly available	b. FA: Fairly accessible

c. NA: Not available c. NA: Not accessible

		RA	FA	NA		RA	FA	NA
a.	Irrigation water							
b.	Irrigation pump							
c.	Information of new practices							
d.	Tractor hiring service							
e.	Financial assistance credit							
f.	Subsidies on inputs							
g.	Access to farm inputs e.g. fertilizers seeds, chemicals etc.							
h.	Access roads							
i.	Health facilities							
j.	Provision of education facilities							
k.	Provision of drinking water							
l.	Access to market for produce							

51. Would you be willing to financially contribute for irrigation water preservation in the Project? Yes [ ] No [ ]

B. If ''No'' Why?

a. I am opposed to such economic approaches [ ]

b. I do not trust the payment authority [ ]

c. I do not have enough money to pay [ ]

d. I believe that it is not me to pay for these services [ ]

e. Others [ ]

55. What was your relationship with neighbouring farmers?

a. Satisfactory [ ]

b. Not satisfactory [ ]

56. Which options for market-based irrigation water acquisition would you prefer?

a. Water rights [ ]

b. Short-term lease [ ]

c. Long-term lease [ ]

d. Dry year options [ ]

57. What category of water market regimes would you operate?

a. Buyer [ ]

b. Self-user [ ]

c. Self-user + Buyer [ ]

d. Self-user + Seller [ ]

58. What mechanism of groundwater extraction did you use on your farm?

a. Average depth of water level__________ (m)

b. Average size of outlet ________________(inch)

c. Engine capacity (HP) ________________(modal value)

d. Water extracted ______________________(Litre/hour of irrigation)

e. Number of wells______________________

SECTION D: Cropped Area and Production Information

58. What was the size of land devoted to crops and output harvested from your plots in1993?

Crops	Farm size (hectares)	Output (Kilogrammes)
a. Maize		
b. Rice		
c. Wheat		

d. Onion		
e. Tomato		
f. Pepper		
g. Okro		
h. Others		
Total		

59. How much was the total cost on the average to produce crops in1993?

₦ _________________

60. How much was the total cost on the average to transport the produce in 1993?

₦ ________________

61. What was the average market price per bag/basket/bundles of the following crops in 1993?

Crops	Price in (Naira)
a. Maize	
b. Rice	
c. Wheat	
d. Onion	
e. Tomato	
f. Pepper	
g. Okro	
h. Others	
Total Units	

62. What was the size of land devoted to crops and output harvested from your plots in2014?

Crops	Farm size (hectares)	Output (Kilogrammes)
a. Maize		
b. Rice		
c. Wheat		
d. Onion		
e. Tomato		
f. Pepper		
g. Okro		
h. Others		
Total		

63. How much was the total cost on the average to produce your crops, harvested in2014?

₦ ________________

64. How much was the total cost on the average to transport the produce in 2014?

₦ _______________

65. Were there available markets for your produce? Yes [ ] No [ ]

66. How did you market your produce?

a) Open village market [ ]

b) Retailers [ ]

c) Wholesalers [ ]

d) Money lenders [ ]

e) Futures market [ ]

f) All of the above [ ]

g) Other (specify) ____

67. What was the average market price per bag/basket/bundles of the following crops in 2014?

Crops	Price in (Naira)
i. Maize	
j. Rice	
k. Wheat	
l. Onion	
m. Tomato	
n. Pepper	
o. Okro	
p. Others	
Total Units	

SECTION E: Employment Opportunities

68. Had the HVIP brought the following social facilities to the area: Tick where appropriate.

a. roads [ ]

b. electricity [ ]

c. school [ ]

d. clinic [ ]

e. good drinking water [ ]

f. recreation [ ]

e. communication network [ ]

h. others(specify)____

69. What employment opportunities did you think HVIP has brought to the area?

a. Trading [ ]

b. Craftwork [ ]

c. Bricklaying [ ]

d. Fishing [ ]

e. Hunting [ ]

f. Transportation [ ]

g. Draught power [ ]

h. Water vending [ ]

i. Hired farm labour [ ]

j. Repairs of pump machines [ ]

k. Sales of spare parts [ ]

m. Others (specify)____

70. Did you agree that, the above wage earning activities have reduced migration of youth from your village to the urban areas? Yes [ ] No [ ]

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

Yes [ ] No [ ]

SECTION F: Assets and Expenditure Profile

72. What is the total amount spent in the household per month on the followings in 2014?

a. Feeding ____ ₦

b. Healthcare ____ ₦

c. Children's education ____ ₦

e. Energy (electricity/Firewood/Petrol) _________________________________₦

f. Entertainment (ceremony/gifts) ______________________________________₦

g. Clothing ____ ₦

h. Lighting ____ ₦

i. Other (Specify) ____ ₦

j. House repairs ____ ₦

k. Automobile repairs ______________________________________ ₦

l. Equipment repairs _______________________________________ ₦

m. General repairs (house/automobile/equipment _________________ ₦

73. Indicate the total number and value of assets possessed from irrigation farming in 2014.

Assets	Number/type	Unit/price	Total Value
a. Buildings			
b. Farm equipment: Tractor			
Pumping machine			
Dryer			
Others (specify)			
c .Vehicles/Automobiles: Car			
Lorry			
Motorcycle			
Bicycle			
Others (Specify) ….			
d. Electrical durables: Refrigerator			
Deep Freezer			
Cooker			
Others (Specify)			
e. Electronics: Radio			
Video			

Television			
Video CD			
Rechargeable lamp			
Satellite			
Others (Specify) …			
f. Farm animals: Cattle			
Sheep			
Goat			
Poultry			
Others (Specify)			
g. Others (Specify) ……..			
Total (Naira)			

SECTION G: Constraints faced by Respondents in the implementation of Project activities

74. Could you give your opinion on the responses provided below?

SA: Strongly agree A: Agree D: Disagree SD: Strongly Disagree

Response	SA	A	D	SD
a. Work environment was very unfriendly				
b. We always worked under pressure				
c. There was higher cost of farm inputs e.g fertilizer, fuel, agro-chemicals				
d. There was poor infrastructural facilities e.g road, recreational facilities				
e. There was limited literacy				
f. There was delay in the distribution of farm				

inputs				
g. No service provided at all.				

75. Was there any environmental degradation as a result of HVIP project activities?

Yes [ ] No [ ]

76. If yes, what was the degree of occurrences?

Problems	Frequently	Not frequently	Rare
a. Siltation			
b. Erosion			
c. Weed infestation			
d. Loss of farmland			
e. Water pollution			
f. Flooding			
g. Others (specify)........…			

77. What did you think was 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)____________________________________

78. Did you have problem with irrigating your plots due to incidences above?

Yes [ ] No [ ]

79. Did you encounter outbreak of water related diseases?
Yes [ ] No [ ]

80. If yes, name the disease outbreak

____

____

81. What was the prevalence?

a. Frequent [ ]

b. Sometimes/ occasional [ ]

c. Once only [ ]

d. Others (specify)___________________

82. What was the prevalence of the following diseases in your village?

Diseases	Frequent	Not frequent	Rare
a. Schistosomiasis			
b. Malaria			
c. Nematodes			
d. Ringworm			
e. Others (specify)			

83. What other problems did farmers encounter in the HVIP projector non-project area apart from the ones mentioned above?

____

____

____

84. What general suggestions could you give to improve irrigation farming in the HVIP area or non-project area?

____

____

____