# IMPACT OF PARTICIPATORY IRRIGATION MANAGEMENT (PIM) ON THE LIVELIHOOD OF WATER USERS IN KANO RIVER IRRIGATION PROJECT (KRIP), NIGERIA

**BY**

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

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## DECLARATION

I hereby declare that the work in this thesis entitled **"Impact of Participatory Irrigation Management on the Livelihood of Water Users in Kano River Irrigation Project (KRIP)"**has been conducted by me in the department of Department of Agricultural Economics and Rural Sociology. All information utilized as literature has been duly acknowledged in the text and a list of references provided. This dissertation was not been previously produced and submitted in this or any other university by anybody else.

**Salisu Kura HARUNA** **Date**
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**CERTIFICATION**

This thesis entitled: **"Impact of Participatory Irrigation Management (PIM) on the Livelihood of Water Users in Kano River Irrigation Project (KRIP)**",bySalisu Kura **HARUNA** meets the regulations governing the award of the Degree of Doctor of Philosophyof the Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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## DEDICATION

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## LIST OF ACRONYMS

**ADENI** Agricultural Development in Nigeria

**ADPs** Agricultural Development Projects

**AFJAM**Agency Farmer Joint Management

**BLRM**Binary Logit Regression Model

**BRS** Bureau of Rural Science

**CBN**Central Bank of Nigeria

**CIRAD** Centre de Corporation International En Research Agronomique pour le Development (International Center of Agricultural Development)

**DCs** Distributary Canals

**DEAT** Department of Environmental Affairs and Tourism

**DFID** Department for International Development

**EAs** Extension Agents

**FAO** Food and Agriculture Organisation

**FCs**Field Canals

**FDID** Federal Department of Irrigation and Drainage

**FMI**Farmer Managed Irrigation

**FSI** Food Security Index

**GDP** Gross Domestic Products

**HJRBDA**Hadejia Jama'are River Basin Development Authority

**HHS** House Hold Size

**HVIP**Hadejia Valley Irrigation Project

**IAs**Irrigation Agency

**IAR** Institute of Agricultural Research

**IIMI**International Irrigation Management Institute

**IMT** Irrigation Management Transfer

**IWMI** International Water Management Institute

**KRIP**Kano River Irrigation Project

**LGAs** Local Government Areas

**LRA**Logistic Regression Analysis

**MCs** Main Canals

**NACRDB**Nigerian Agricultural Cooperative and Rural Development Bank

**NAERLS**National Agricultural Extension and Research Liaison Services

**NCWR** National Council of Water Resources

**NDRBDA** Niger Delta RiverBasin Development Authority

**O&M**Operation and Maintenance

**OMM** Operation, Maintenance and Management

**OORBDA**Ogun-Osun RiverBasin Development Authority

**PIM** Participatory Irrigation Management

**PM&E**Project Monitoring and Evaluation

**RBDA**River Basin Development Authority

**ROPISON** Review of Public Irrigation Sector of Nigeria

**SEIA** Socio-Economic Impact Assessment

**SIA** Social Impact Assessment

**SLs** Sustainable Livelihoods

**SRRBDA**Sokoto Rima River Basin Development Authority

**USAID**United State Agency for International Development

**WCS** Water Control Structures

**WIP** Watari Irrigation Project

**WUAs**Water Users Association

**WUs**Water Users

## ABSTRACT

The study was conducted to assess the impact of Participatory Irrigation Management (PIM) on the livelihood of water users in Kano River Irrigation Project (KRIP). A sample size of 325 and 268 water users from KRIP and Watari Irrigation Project (WIP) were selected by using systematic random sampling techniques making a total of 593 water users (WUs) used for this study. Data were collected through administering questionnaire, which were analysed by descriptive statistics, multiple regression, independent t-test, chow test and propensity score matching. Therespondents had about 17 years mean irrigation experience and 61.5% and 16.1% of WUs in KRIP and WIP registered with WUAs. On the extent of participation, KRIP and WIP water users had 84% and 46%, 52% and 23% level of participation on field canal and distributaries canal weeding. It was indicated that water users in KRIP broaden their cropping patterns there by planting about eight (8) different crops whereas WUs in WIP concentrated on four (4) crops only. With regards to the factors influencing WUs' participation in PIM intervention; farming as major occupation of WUs, experience in irrigation farming, Member ship in water users association (WUA) and extension frequency had a positive influence on WUs' participation in irrigation management at 1% level of significance,. The study revealed that leadership capabilities, water users' knowledge on WUAs status, Productive meeting and voluntary labour contributions were the perceived roles effectively played by WUAs' officials according to 72.6%, 69.4%, 63.8% and 73.4% of the respondents in KRIP however, perceived contrary by WUs in WIP. Regarding to agency roles; training of water users on how to operate and maintain irrigation infrastructures were considered not effective in the areas. Though dealing with canal breakers was considered effective by 72.2% level in KRIP, while 45.6% level in WIP was considered not effective. The overall average matching estimates shows that PIM intervention improved WUs' livelihood by 0.169 coefficients at 1% level of significance. The result revealed that degradation of soil (64%), none enabling environment for water users to participate in irrigation management (61.5%), low water users' orientation on Operation and Maintenance (O&M) (60.9%) ,water user's poverty level 59.4% high cost farm inputs (57.2%), lack of sense of ownership by WUAs (86.2%) , failure of agency to make good arrangement for adequate and timely water supply (66.7%) and WUAs official and agency personnel's non-transparency (58.5%) were the major challenges against effective operationalization of PIM. Based on the finding of the study it wasrecommendedthat WUAs should be strengthen in KRIP while sensitization and mobilization campaign should be adequately mounted in WIP, Agency and WUAs officials in KRIP and WIP should put head together in mobilizing water users to improve participation on field canal clearance and distributary canals de-silting and weeding; agency should give room for water users involvement in decision making process.It was suggested further study should be conducted toanalyses the stage of Participatory Irrigation Management in Nigerian Large-Scale Irrigation Schemes managed by Federal Ministry of Water Resources; Comparative evaluation of the performance of Irrigation Infrastructures in PIM and non PIM Implemented Irrigation Schemes in Nigeria and Effect of Water Users Conflict in Nigerian Large–Scale Irrigation Schemes: Causes and Mitigating Strategies.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background to the Study

The significance of irrigated agriculture to Nigeria is related to the availability of vast arable land, increase in population density and the fact that agricultural sector serves as major source of employment to about 65% of the population (Othman *et al.*, 2006). Large scale Irrigation projects came into being after Sahelian drought (in mid-70s), the era which coincided with the oil boom in Nigeria. The Food and Agriculture Organisation (FAO) and United State Agency for International Development (USAID) in 1960's identified attractive sites for large scale irrigation development along Sokoto Rima Rivers and Hadejia Jama'are. The subsequent review of the studies marked the turning point of Large Scale Irrigation Project in Nigeria in 1970's. The eleven (11) River Basin Development Authority (RBDA) covering the whole country were constructed in 1976 where most of the irrigation activities are in the North because of the seasonality of the rivers and existence of large human population near alluvial plains (Musa, 2001).

Similarly, government efforts towards achieving self-sufficiency in food production in Nigeria emphasized the optimization of irrigation. Study (Dogara, 2003) has shown that from 1960 to date more than 100,300ha were developed for the production of irrigated crops under agency managed irrigation scheme. Also a study carried out by Musa (2001) shows that Nigeria has a potential of about 1.4 million hectares of informal irrigation schemes sprang up all over the flood plains areas along its river valleys.

Large scale irrigation projects have generated year-round employment for rural households, and increased job opportunities among women. It also provided sufficient incentive to slow down the process of urban migration. Empirical study (Shevah, 1993) indicates that Kano River Irrigation Project (KRIP) is playing an important role in limiting migration from rural areas to urban centers and alleviating employment problems. Employment generation and stabilization of the rural population are undoubtedly among the major social benefits of the KRIP. Another important outcome of the KRIP is the increased income and improved living standards of the farming population. The project has successfully relocated part of the population to villages with better road network, without radically disrupting the traditional way of life.

In spite of the above, there was a serious declined in hectares of land under government own irrigation schemes most of which are managed by Hadejia Jama'are River Basin Development Authority (HJRBDA) (Adeneji, 2001, Othman and Abubakar 2004). This situation creates a fear that Nigeria cannot achieve its potential for enhancing wide coverage of hectares under irrigated agriculture (Musa, 2001).

PIM is a joint management of irrigation system and decision making in Operation and Maintenance (O & M) of irrigation scheme between the beneficiary farmers and agency personnel, in this arrangement the agency is responsible for O&M at head works (main system) and secondary level while the farmers are responsible for tertiary and quaternary system levels, payment and collection of water charges as well as involvement in decision-making.

Nizamedinkhodjayeva (2005) in his study concluded that in considerable number of cases, rural poverty is caused by worsening access to irrigation water. Irrigation water is an asset and its availability increases household capacity to produce income in combination with other assets. It largely contributes to food security of the rural population. In particular, irrigated agriculture contributes 30-40 per cent of the Gross Domestic Products (GDPs) of three Central Asian countries, namely: Kyrgyzstan, Tajikistan and Uzbekistan (World Bank, 2003). Apart from irrigated agriculture, Ellis, (2000); and Lankford (2005) identified that almost every non-farming livelihood activity of the rural poor needs water.

Irrigation development requires not only the proper mix and utilization of resources, but also their conservation and renewal. The most effective way of bringing this is through well-articulated programmes of social mobilization and farmers' participation in the irrigation development process to attain proper maintenance and sustain increased productivity in the project area. Currently, farmers' roles are highly limited and, in most cases, are reduced to using water and paying for it. Thus, this top approach relationship has developed between farmers and government officials. Therefore the existing problems are reflected in water shortages, silted canals, breakage and blocking of canals, poor maintenance of system structures and inequitable water distribution (Musa, 1993). These associated manpower limitation, institutional, financial and engineering constraints marked the starting point of low performance of irrigation schemes in Nigeria (Musa 2001, Akinkoye, 2001; Dogara, 2003 and Haruna, 2004). The alternative option against low or poor performance of large scale irrigation system is the Participatory Irrigation Management (PIM) for sustainability and responsibility sharing among the stakeholders (Othman and Abubakar, 2004).

To improve farmers' participation and involvement, irrigation agencies and other stakeholders should re-activate the existing services to provide direction, training and contact with the community while encouraging and emphasizing formation of water users groups and initiatives in system management. Ways and means of passing some of the management responsibilities onto the Farmers' Group and the private sector should be devised. The role of Hadejia Jama'are River Basin Development Authority (HJRBDA) in this respect should be geared towards coordination, education, supervision and provision of major services and facilities (Abubakar, 2009).

Farmer participation in irrigation management started at the early period of irrigation projects, where farmers formed group for input procurement and land preparation. Nonetheless, this is not enough to reduce the financial burden on the agency in terms of operation and maintenance of the system. The second attempt was through implementation of collaborative research on the introduction of Farmer Managed Irrigation (FMI) system using three sectors (Bangaza, Agolas and Karfi) as pilot site (Ahmed 2001). The first of the collaborative work was sponsored by Ford Foundation in 1986/87. The research was jointly conducted by IAR (Institute of Agricultural Research), HJRBDA and IIMI (International Irrigation Management Institute) Sri Lanka. The totals of 893 farmers were selected from their irrigation communities (sectors). The de-silting of 10.5 km of DC marked the success of the research between February to March 1993. The third attempt in 1996 was the expansion of the research activities under CIRAD (*Centre de Corporation International En Research Agronomique pour leDevelopment*), HJRBDA and NAERLS collaborative project in HVIP and KRIP and the project terminal phase was in 2000 and the project winded up in 2002 without involving farmers' participation in the activities. The

CIRAD,HJRBDA and NAERLS in 2002 gave birth to another three years community development project called Agricultural Development in Nigeria (ADENI) supported by the French Embassy in Nigeria. The project was implemented in five sites in which KRIP was one of them. The main objective of the intervention was to contribute to the improvement of small scale farmers' livelihood through strengthening of the farmers' organizations in order to have a better role in community development functions (techno-economic, representation, social aspect etc.) among all the stakeholders. The project was extended by one year twice following the request made by Nigerian authorities and farmers (Othman *et al.*, 2006).

**1.2 Problem Statement**

The inability of project implementation to match the design in Nigeria has led to a number of abandoned or poorly maintained projects in the country. Most of the projects in Nigeria were not very effective due to poor projects design in some cases and also poor maintenance (management) culture that militates against proper implementation and management of the projects. Agriculture is undergoing transformation with the aim of improving the living standards of the farmers and providing food security to the country.

However, a study carried out by Omokore (1993) showed that lack of sound policy coordination resulted to uprooting agricultural population which exposed them to grapple with socioeconomic adjustment. Other factors that caused some of development projects in Nigeria not to accomplish its goals include: Low level of technology, low financial capacity, continued dependency on and consequent dictations from internal and external forces; and poor ethical behaviour.

One of the lingering crises of irrigation management is poor participation of farmers in system maintenance and lack of their involvement in decision making. The paradigm shift of irrigation management from agency sole management to farmer agency joint management is adopted in some RBDAs to reduce the cost of operation and maintenance by agency and to ensure farmers' sense of ownership; the process/concept which Pradhan (1992) described as Participatory Irrigation Management (PIM). At the time of its introduction, farmers' dependency on agency for input supply and O&M responsibilities was very common. In such a situation the agency was overwhelmed with irrigation responsibilities; right from farm operation at farm level to main source of water. The extent of farmer participation in decision making was very low and was restricted mostly to farm operation and field canal maintenance. Such existing problems of low participation have weakened the farmers' payment of water charges and group collective action.

The expectation of intervening agencies into irrigation management via participatory approach to ensure collaborative effort between irrigation agency and farmers' group (Water Users Association) as legal entities ensure the sustainability of irrigation management. PIM emphasizes that greater responsibilities, concern and authority should be assigned to the water users to participate in decision making process equivalent to that of agency personnel (Abubakar, 2009). In Nigeria no irrigation agency has attained this level (Musa, 1993). A tripartite intervention of CIRAD/HJRBDA/NAERLS for joint management of irrigation system among the stakeholders of the irrigation schemes was brought about to correct these lapses of irrigation management. Musa (1993) added that

PIM concept was successfully implemented and evaluated in Asia, Latin America and Europe.

However, no attempt has been made to study the impact of PIM on water users' livelihood in irrigation schemes managed by River Basin Development Authorities particularly, KRIP to evaluate the success or failure of the irrigation management transfer interventions' objectives. This study, therefore, provides answers to the following research questions:

**(**i) What are the socioeconomic and institutional characteristics of water users in the study areas?

(ii) To what extent are water users involved in the management of irrigation scheme?

(iii) What are the level of water users' income sources and crop diversification?

(vi) What are the socio economic factors influencing water users' participation in PIM intervention?

(v) What are the perceptions levels of water users' on WUAs officials and agency role effectively played in the management of irrigation system?

(vi) What are the impacts of PIM on the livelihood of water users'?

(vii)What are the constraints encountered by PIM beneficiaries?

### 1.3 Objectives of the Study

The broad objective of the study was to assess the impact of Participatory Irrigation Management on the livelihood of water users: The specific objectives were to:

(i) describe the socioeconomic characteristics of water users in the study area;

(ii) assess the extent of water users' involvement in the management of irrigation system;

(iii) examine the level of water users' income sources and crop diversification;

(vi) determine the socio economic factorsthat influence water users' participation in PIM intervention ;

(v) ascertain the water users' level of perception of WUAs officials and irrigation agencies roles effectively played in the management of irrigation system;

(vi)determine the impacts of PIM on the livelihood outcomes of water users;

(vii) describe the constraints encountered by PIM beneficiaries.

**1.4 Justification of the Study**

Water is one of the most important inputs for sustaining agriculture. In view of the increasing demand for water for agriculture and other purposes, there is urgent need for efficient use of water. Due emphasis required to be laid on both efficiency in the use of water through appropriate demand side management and on the efficiency of created facilities for the utilization of water. It is assumed that proper management of irrigation scheme could enhance increase in the present level of water use efficiency in irrigation projects. An additional coverage of hectares can be brought under irrigation from the existing irrigation capacities and that in turn would involve only a very moderate investment as compared to the investment that would be required for creating equivalent potential through new scheme technologies.

Many a time, efforts were aimed at improving the irrigation system efficiency which focused mainly on the structures, technology and environment rather than the end users (actual beneficiary of the irrigation projects). For irrigation research to bring out successful and good output, it is necessary that more attention should be paid to the farmer on the field. In view of this, there is a need to fully understand water users' attitudes toward

irrigation management transfer which differ according to the way they were expected to take part in the management and O&M of irrigation schemes endowed. There is also a need to evaluate the constraints to operationalization of participatory irrigation management for the livelihood sustenance of the beneficiaries of irrigation projects.

The motive behind the idea of PIM is mainly because of the expansion of irrigation area and complexity in collecting water charges; difficulties faced by centrally financed bureaucracies to effectively provide water services to large number of small scale farmers (Vermillion, 1997., and World Bank, 1999). A lot of studies (Ganapathy, 2008; Reddy *et al.,* 2005; Haruna, 2004) have been carried out on constraints to farmer participation in irrigation management. However, there is no available research work carried out to assess the impact of PIM intervention on water users' livelihood in the study area. This study filled the gap in the existing knowledge of impact of participatory irrigation management. This justified the need for comprehensive study of the impact of PIM on the livelihood of water users in the study area. The finding from the study helped in evaluating the significance of irrigation management intervention in improving the livelihood of water users and other categories of irrigation management stakeholders. The research also generated information on the impact of intervention in irrigation management by able agencies on the livelihood of irrigation farmers, for proper policy planning and implementation in Nigerian Large Scale Irrigation Scheme and provides secondary information for research institutions and other non-governmental agencies.

### 1.5 Hypotheses of the Study

The following hypotheses were tested in null form (Ho):

$Ho_{1:}$ Socio-economic and institutional variables of the beneficiary water users have no significant influence on their participation in the PIM intervention.

$Ho_{2:}$ Participatory Irrigation Management intervention has no significant impact on the livelihoodof water users.

### 1.6 Scope and Delimitation of the Study

Though impact study of a given intervention encompasses the subsequent/ spillover effects on production, income, environment, and on social welfare in general, this study gave more emphasis on direct impact using with and without approach. The impacts variable outcomes are particularly on livelihood which comprises; crop production, income generation activities, assets possession, food security, access to adequate irrigation water and sustainable use/management of the resources (irrigation infrastructures) of the project's intervention. Intervention of CIRAD/ NAERLS/ HJRBDA on PIM covers KRIP and HVRIP of HJRBDA, however, the intervention was carried out at different periods. This study covered KRIP where intervention was about six (6) years old, and data were collected from sampled water users in the study area. Despite the resource limitations, the study generated important information for irrigation management stakeholders (government and nongovernmental agencies, and farmers).

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

Agriculture provides jobs to about three quarter of the Nigerian working population. A survey (JICA, 1995) revealed that 39 percent of Nigerian land mass is suitable for agriculture and 4.5 to 5.0 percent (4.0 and 4.5 million hectares) are suitable for irrigated agriculture. However, only 1.1 million ha can be supported by available water while the remaining 3.4 ha being in *fadama*. The land holding for agricultural activities in Nigeria is generally small and scattered with average holding between 0.5 and 5.0 ha. The farming is generally rain fed and subsistence in nature, where farmers are using simple farm tools and farm land belonging to a community. Nonetheless, the existence of large scale public irrigation schemes and cooperative societies shift the status of some peasant farmers to medium and large scale producers (Iloeje, 1981).

In the past decades of 1970-1990, Nigeria realized the expansion of irrigated agriculture sponsored by the federal and some states government of Nigeria. However, the effort has been slowed down gradually few years later. The investment for new construction and appropriation for the cost of operation maintenance and management of the existing project become no longer significant which eventually creates a situation where personal cost could not been covered. In that respect the federal government of Nigeria decided to partially commercialize the irrigation agencies by imposing payment of water charges and operation,

maintenance and management (OMM) expenditure at tertiary and secondary levels of public large irrigation schemes (Musa, 1993).

### 2.2 Socio-economic Characteristics of Water Users

One of the common features of smallholder irrigation schemes highlighted by May (2000), and Aliber (2003), is that most of them are found in the deepest corners of the rural areas where poverty levels are very high, with only a few locating closer to towns. Thus, the role of the schemes in such areas is to try and help these rural farmers improve their livelihoods and hopefully escape the vicious circle of poverty that has been so severe in most rural areas of the developing nations. Chambers (1983) also believed that as a tool of improving rural livelihoods, these smallholder irrigation schemes act as vital assets that can be used to increase and diversify the livelihood activity in plant production, resulting in improved livelihood outcomes. This improvement in livelihood outcome can either be directly, in the form of food or income for farm plot holders or indirectly by providing full or partial livelihoods to people who provide goods and services in support of irrigated agriculture on these schemes.

Empirical evidence presented by Food and Agriculture Organisation(2000) showed that most of the small-scale irrigation schemes in Africa are run by women and these women-run schemes are more successful than those owned by men. Food and Agriculture Organisation(2000) further establish that the dominance of women can be explained by the fact that the plot sizes cultivated are often too small for households to be able to get enough income with which to sustain their livelihoods, hence men leave their women behind as they seek alternative sources of income such as formal sector jobs for wages and salaries.

### 2.2.1: Irrigation and rural livelihoods

The general trend by most agricultural economists regarding agriculture as a tool for alleviating poverty has led to the perception that most rural households should engage in farming to improve their livelihoods. However, in the South African context, it has also been confirmed through a number of studies done by World Vision (2004), Monde (2003), just to mention but a few, that agriculture in most rural households hardly ever constitutes the main rural livelihood activity to secure income and household food security. One of the reasons for this is that these rural irrigators only get small pieces of land to cultivate and this, coupled with the low demand elasticity for the farm products, has made the small scale irrigation sector not to be a viable source of sustainable livelihoods. As a result, such households depend on other sources of income such as formal sector wages and social grants to supplement their agricultural income, a move that has left most of these irrigators only to participate in the fields on a part-time basis (Shah*et al.*,1992).

Most of development plans for Nigeria, have focused on the belief that the best way to achieve increased productivity in agriculture is through new and usually imported technology combined with the teaching of farmers to become commercial businessmen. This pattern assumes that larger and more sophisticated farming schemes are more able to produce surplus food beyond family consumption but in a marketable quantity. Such plans focus on mechanized and commercial farming to adequately feed the industries, while the poorest and majority of farmers are ignored. Little attention was given for provision and improving of rural infrastructures (Shah*et al.*,1992; Monde, 2003).

This type of development plan is demonstrated by the Kano River Project in Kadawa and Sokoto Rima Kadawa Irrigation Projects which were built primarily for the production of wheat and tomatoin the dry season. These large scale irrigation schemes combined large costs for set-up with significant ongoing costs for farmers since they needed to pay for the use of equipment like tractors, seeds, and pesticides. The projections made by the Dutch consulting firm Netherland Engineering Consultants (NEDECO), which was involved with this project failed due to low productivity. The affected Irrigation Projects attempted to transform their farming system from one where farmers primarily grew their own food and were essentially self-sufficient, to one where they grew food for the market and must buy food to meet their own needs. Given the problems, and few realized benefits, associated with this type of agriculture the farmers of this region were quite resistant to these massive changes and the Kano River Project is only a fraction of the extent that was planned. Furthermore, large scale irrigation projects such as these have a characteristically poor performance record and are often associated with the soils degradation problems, difficulty in managing the irrigation infrastructures and high cost of labour (Harris and Yusuf, 1996).

Most of livelihood activities in KRIP and WIP(Watari Irrigation Project) identified were related to irrigation farming. They include: diversified crop production, assets possession, food security, increased crop yield and accessibility to adequate irrigation water. The water users with most secured livelihood outcomes were managing some small scale business; they partake in non farming business like artisan jobs and petty trading etc. These non agricultural businesses are indirectly dependent on access to timely and adequate irrigation

which determine crop yield, which consequently determine their income. This corroborated that of Nizamedinkhodjayeva (2005), who opined that access to irrigation by farmers influences their productivity and other non agricultural business, like making of box for packaging of vegetables. Also Huang, *et al.* (2006) identified the significance of farmers' involvement in irrigation farming on creating nonfarm employment opportunities which influence their consumption expenditure.

### 2.2.2: Ownership of landand access to capital resources

In Nigeria, there are a number of irrigation schemes that were initiated by the government at the time of oil boom in the 1970's with the aim of converting large arable land into cultivation to provide employment and self-food sufficiency (Othman, 2004). These schemes were basically run and managed by government irrigation agencies. With rapid growth of population in most of the communities benefitted from irrigation project, land holding is becoming fragmented as many farmers are having small proportion of land that will not fit for commercial or large scale agricultural production.

Lack of sufficient funds to carry out farm operations and non access to credit were the major problems identified facing farmers of the various RBDAs. Consequently there is a great limitation to the extent that farmers could not expand their scope of operation. Normally, farmers' sources of funds come from their personal savings or loans from friends, local money lenders and family. In most of RBDAs there are few farmers' groups/cooperatives that access credit through such cooperative organisations but at very high interest rates which invariably discourages farmers. Despite the presence of official sources of credit facilities to farmers such as Commercial Banks and nearly all the

Community Banks operating under the Agricultural Credit Guarantee schemes of the Central Bank of Nigeria (CBN) as well as the Nigerian Agricultural Cooperative and Rural Development Bank (NACRDB), farmers access to credit became a problem due to high protocol involved in the loan process. To access the banks' loan facility, prospective farmers, individuals or groups would have to open and operate accounts committed with the banks (FAO and Federal Ministry of Water Resources, 2004).

## 2.3 Concept of Participatory Irrigation Management (PIM)

The World Bank (1996) defines Participatory Irrigation Management (PIM) as "the involvement of irrigation users in all aspects and at all levels of irrigation management". "Involvement" is flexible, ranging from light involvement like information sharing, consultation, and joined assessment of problems to real involvement like shared decision making, collaboration, and full say by the water users. The World Bank employs the word userism to express the essence of PIM, because it is management of the users, by the users and for the users. The concept of PIM is then also related to the concept of Water Users Associations (WUAs), "All aspects" including initial planning and design of new irrigation projects or improvements, as well as the construction, supervision, and financing, decision rules, operation, maintenance, monitoring and evaluation of the system, "All levels" include tertiary, secondary, main system level as well as project and sector level.

PIM may include the reordering of control over (claims to) water, the redefinition of boundaries and domains of governance and the construction of new entities (WUAs, etc.). There is however, a large variety of functions that can be transferred, the degree of transfer of the different functions, and the organisational set-up aimed at after transfer. This is due

to the fact that participation in irrigation management by water users can take a wide variety of forms. Farmers can be involved in various system management functions, including planning, design, operation, maintenance, rehabilitation, resource mobilization, and conflict resolution. Moreover, they can be involved in these functions at various system levels: from the field channel to the entire system. Almost all irrigation systems show some involvement of water users in the system management. When people speak of introducing PIM, they are usually referring to a change in the level, mode, or intensity of user participation that would increase farmer responsibility and authority in management processes (Svendsen, Trava and Johson, 2000).

Though, the concept of PIM is closely linked with the concept of Irrigation Management Transfer (IMT) indeed, IMT is a subset of PIM. IMT can be defined as the transfer of responsibility and authority for irrigation system management from government agencies to water users associations, or other private sector entities. This is a broad and rather vague definition. IMT may include transfer of decision-making authority (or governance). It may include transfer of ownership of scheme infrastructure (which is normally considered privatisation). It may include transfer of water rights from government to water users associations. Otherwise it may only include turning over to water users a part of the management responsibilities, such as water delivery, canal maintenance and fixing the water fees, while final approval of operation and maintenance (O&M) plans and budgets are subject to government approval (FAO, 1999).

The PIM concept had been introduced in some schemes like KRIP in HJRBDA, and Lower Anambra Irrigation Project (LAIP sometimes in the early 1990s; however, it was only in

1998, at the sitting of the National Council of Water Resources (NCWR) in Sokoto, that all irrigation agencies were mandated to adopt the PIM concept in all their schemes (Musa, 2001). Field investigations indicated that the PIM concept so far is understood and implemented by some of the RBDAs, through the establishment of WUAs and their involvement in the maintenance of the tertiary canals and drainage network. They have been active in the collection of water charges. Apparently they have not been assigned any management responsibilities and still operate as farmers cooperatives (FAO and FMWR, 2004).

Similarly, participation has been broadly defined by World Bank (1992) as a process by which people, especially disadvantaged people, influence decisions that affect them." "Participatory Irrigation System Management" was implemented in different stages and time by CIRAD in 1993 as AFJM. The objectives of the programme were to:

i. relieve the government of the financial burden of funding recurrent expenditures for irrigation
ii. improve the maintenance of irrigation facilities and the irrigation service
iii. enhance the productivity of irrigated land and water
iv. promote a spirit of self-reliance among farmers in irrigation schemes (Othman and Abubakar, 2004)

WUAs/Farmer organizations are fundamental to participatory irrigation management. Their main functions is to deal with irrigation matters, payment and collection of water dues and participation in decision making, market farm produce, procurement and distribute production inputs and resolving conflict among water users.

## 2.4 Paradigm shift in Irrigation Management in Nigeria

The Federal Government policy of commercialization in 1987 led to the withdrawal of the provision of extension services in RBDA. In that respect, the HJRBDA, among the RBDAs, was mandated with provision of water from head works to the secondary levels where as farmers and other categories of users were saddled with responsibilities of maintenance and management of the scheme at tertiary level as well as to pay and collect water charges from the farmers (Ben Musa1990 and Abubakar *et al.,* 2009). More so the policy that fixed the water charges arbitrarily created a gap in the performance of farmers and their capacity to shoulder the added responsibilities, which would in turn determine their ability to pay for the charges and sustainably operate the tertiary part of the system. Consequently, many schemes recorded sharp decline in productivity and very low cost recovery (Olugbemi *et al.,* 1993). The government faced with implementing structural adjustment programme completely reviewed subvention for O&M to the RBDAs, and without cost recovery from the beneficiaries to fulfill their O&M obligation to the users, deterioration set-in, which further lowered the irrigation performance leading to the vicious cycle of poor infrastructure, poor management, poor services etc. (Musa 1991, Abubakar, 1999;DID, 2004).

The negative effects of the above circumstances called for the policy challenges and political will, institutional capacity; human and technical resources and expertise; financial resources, pro-poor and sustainable management strategies that involved all parties, but most especially the one with highest stake and interest in irrigation namely the land owners

and users of the facilities. Exploiting this opportunity called for PIM holds great potentials for the improved performance of irrigated agriculture in Nigeria (Abubakar, 2004).

### 2.4.1 Classification of Irrigation based on characteristics

Understanding the trend of Participatory Irrigation Management (PIM) and policy backing it is very essential for developing a comprehensive strategy to its implementation. An irrigation system functions not only as a food provider but also as a support for commercial or tradable crops. Therefore, the characteristic differences of irrigation management shifts between protective and productive irrigation are shown in Table 1 (Pusposutardjo, 1999) below.

Table 2.1: Classification of Irrigation base on characteristics

| No. | Descriptor | Protective irrigation | Productive irrigation |
|---|---|---|---|
| 1. | Objective | To protect crops from water insufficiency due to climate change. | Optimum water sufficiency for Cultivation. |
| 2. | Basic management Principles | Uniformity of water distribution throughout the command area. | Productivity value of land-receivedirrigation water. |
| 3. | Cultivated crop | Food crops as a part of subsistence Farming. | Tradable crops demanded by the market. |
| 4. | Product orientation | Certainty on farming system | Optimal production with financial benefit. |
| 5 | Water status | Water as an input to protect production Crops. | Water as a capital of farming system. |
| 6. | Expected management system | Distribution of water. | Water supply with optimum productivity of the farming system. |
| 7. | Irrigation system network | Good irrigation system. | System of supply, distribution, and control of water shortage and excessive water. |

Source:Adapted fromPusposutardjo, 1999.

### 2.4.2: Farmers' organizations and participation in irrigation management

The Water Users' Associations (WUAs) generally refer to the grouping of farmers usually of one hydraulic unit, command, or irrigation community, in one formal body for the purpose of managing parts of irrigation system (Hallai,2001). The motive behind the establishment of WUAs is to ensure optimum utilization of water resources through the participation of farmers in the management of irrigation facilities and in the decision making process. The blue print approach to WUA formation and development is to be exploited because of the great disparity in the dynamic social, economic and political setting of irrigation communities and situations.

Farmers are organised into some form of cooperatives or other groups in all the zones by many of the RBDAs. In areas close to large water bodies such as the Lake Chad and reservoirs of dams, Fishing and/or Boat transportation groups have been formed. In all cases, the farmers actively participate in cultivation, but in many schemes hardly play any role in management and maintenance of irrigation structures outside their plots. In a few pilot schemes, such as Kpong in Niger Delta Basin Development Authority (NDBDA) (presently abandoned), farmers were not even involved in cultivation. Farmers' interaction with RBDAs varies widely. In some schemes, farmers are left largely on their own and in others, the farmers toe the line dictated by the agencies that provide them with farm inputs and even assist in harvesting. A lot of post-harvest loss was observed as a result of farmers being handicapped to market their produce as a group. This is further compounded by the lack of storage facilities (Hallai,2001).

However, in 1995, *Centre de Corporation International En Research Agronomique pour le Development (CIRAD),* in association with the National Agricultural Extension and Research Liaison Services (NAERLS) of Ahmadu Bello University Zaria and HJRBDA, under a research programme to promote Agency Farmer Joint Management, established a WUA unit in the Hadejia Valley Irrigation Project (HVIP). In spite of the achievements recorded e.g. farmer involvement in O&M and access to irrigation water, the programme had a number of constraints such as:

(i) Inter-village and political differences within the individual associations which led to the retardation of WUA development process;

(ii) Inadequate logistic support for WUA unit for effective programme implementation.

Despite this initiative, it was observed in Review of Public Irrigation Sector of Nigeria (ROPISIN) that in all schemes, no effective WUA exists. An organizational structure of a typical farmers group or cooperative consists of a Chairman, Vice chairman, Secretary, Public Relations Officer, Financial Secretary and a Treasurer. The groups do not have any formal constitution guiding them however, they are guided by tradition. At the onset of the irrigation season, the farmers' cooperative usually have a general meeting where major issues that may affect the smooth running of the scheme are discussed and decisions taken. Subsequent meetings are held as the situation demands (ROPISIN, 2004).

### 2.4.3 Extension services delivery in public irrigation schemes

The responsibility of providing agricultural extension services presently rests with the ADPs extension staff of the various State Ministries of Agriculture. However, the ADPs extension services are only provided for the small scale *fadama* schemes as they were not

set up to cater for large scale irrigation schemes. Findings during the ROPISIN revealed that farmers receive skeletal services from the RBDAs, by untrained operatives who are just offering assistance. Consequently, few farmers on Public Irrigation Schemes receive extension services. This lack of service is a major factor contributing to poor farming practices, poor choice of crops and scheduling the production of such crops. Furthermore, a lack of knowledge of basic irrigation parameters and new innovations also contribute to the poor performance, hence yields would be low and farmers' incomes are reduced (ROPISIN, 2004).

## 2.5. Previous studies on Water Users' Participation in the Maintenance of Irrigation Structures

The sustainability of irrigated agriculture in India is in jeopardy due to the low performance of irrigation systems, which leads to an inefficient use of land and water and to an agricultural production much below its potential. Due to unreliable and inequitable irrigation services, indiscipline in the use of canal water has become rampant among farmers and has resulted in resistance to pay seemingly reasonable water charges. Participatory irrigation management and water management by user associations in which the farmers are the managers and the government agencies are the service providers are felt to be the vehicles to bring about a sense of ownership among the farming community. A study by Rao *et al.* (2012) pointed out that the management of the irrigation system at the tertiary level is taking place in an irrigated command area of about 600 ha, serving nearly 300 farmers.

Farmers are partners in planning, implementation and management and they have formed their own water user association. The management goals are: assurance of a reliable water

supply to the farms; adoption of a system of equitable water distribution, appropriate irrigation scheduling and efficient irrigation practices; operation and maintenance of the system by the beneficiary farmers; and creation of community awareness of the activities needed for sustained agricultural production. The associations would contribute labour and manage the rehabilitation of the system.

A study by Haruna (2004) showed the extent of water users' participation at different levels of irrigation management, where majority were found to be participating at farm operation level and in field canal clearance. However, the reverse is the case in other aspects of management. Low participation in management of water control and distribution structures would not be unconnected to the water users' view that participation at this level is beyond their technical and financial capacity, hence government agency should be held responsible. He also pointed out that low involvement of water users in decision making is related to the agency personnel perception that farmers are not technical and literate enough to be involved in decision making.

## 2.6 Socio-economic Factors Influencing Water Users Participation in Large Scale Irrigation Scheme Management

Several factors (Makadho (1993); Murtala 2001and Haruna 2004) have been found to influence farmer's participation in irrigation management. These include government policies, irrigation technologies, market forces, environmental concerns, demographic factors, institutional factors and water delivery mechanism. Specifically, factors such as age of potential user, his/her social status, educational level, household size, and farming experience; Management factors: membership to organizations; Institutional/technology

delivery mechanisms: information access, extension services, and prior participation in system maintenance.

Haruna (2004) found that awareness of PIM activities contributed to participation of water users in irrigation management. This indicates that farmers who are aware of irrigation management activities to be their responsibilities participate more in management activities Also, Makadho (1993) and Murtala (2001) ascertained that for effective users participation in irrigation management activities, sensitization, mobilization and facilitation programmes for water users' participation in irrigation management activities are of paramount importance.

Furthermore, age influences the users' participation in irrigation management in negative direction and the negative effect might be that majority of the respondents fall between the youthful age, who seems to be fairly enlightened and perceived project agency to take the responsibilities of system Operation and Maintenance (O & M) and management (Haruna, 2004). Moreover, years of water users experience significantly influence their participation in irrigation management. This is so because experienced farmers in irrigation agriculture are competent and more committed to irrigation management activities than non-experienced ones. Musa (2009) in his study shows that technical skills and experience are important determining factors of farmers' involvement in irrigation farming.

Farm size determines the water users' participation in irrigation management. Therefore, farmers having a large farm plot seem to have been less participating in irrigation management activities for the fact that they rented out their farm plots to visiting farmers.

Similarly, farmers' perception on irrigation management responsibilities influenced their participation. This implies that farmers perceived large scale irrigation to be a drought relief and social services to be maintained by government free of charge.

## 2.7 Water Users' Perception on Irrigation System Management Responsibilities

To assess the irrigation farmers' perception on irrigation scheme management transfer to local communities and irrigation agency role, one has to trace the historical development of water management in agriculture. There are three basic ways of obtaining water supplies and using them for cultivation, each of which has given rise to a particular type of farming. A sequence of enquiries need to be taking into cognizance to obtain farmers views of what factors limit their ability to manage their irrigation systems as effectively and efficiently as they would like to. In general, few farmers perceive they have problems with deciding when to irrigate and how much to put on (determinants of efficiency). The most frequently cited problem is with water supply and maintenance of irrigation infrastructures. These problems had two aspects: the capacity of the on-farm system and the reliability of supply (from rivers and schemes). The first is a matter of design and the second is a matter of water source and delivery structures management. The effect of both problems is to limit farmers' ability to apply water in the amounts they believe are necessary for crop production. The primary issue is effectiveness (production), not efficiency.

Irrigators are with opinion that the concepts of irrigation management and sustainability varied widely. Most irrigators where primarily concerned about the output and income sustainability of irrigated agriculture and believed that getting the economics right would involve a number of factors of which irrigation system sustainability would be most

paramount. They perceived that farming should be sustainable within the limits of their financial and physical resources with government having or responsible for the maintenance of irrigation system (Lincoln, Environmental, 2000).

It is also perceived by water users that government has to create an enabling environment through policy resolutions, and specific programs of activities to be implemented and sponsored by the government. Providing technical advice and technical back up, as well as funds, to WUAs for selective activities, ensuring attitudinal and behavioral change amongst employees of all government departments directly or indirectly concerned with irrigation agencies. Similarly irrigators sees Water Users Association (WUA) as co-operative association of individual water users who wish to undertake water-related activities for their mutual benefit act as an interface between the farmers and the main system management responsible for water distribution, operation and maintenance of the irrigation and drainage system, collection (and assessment) of water charges and resolution of local disputes amongst members.

In most developing countries, large-scale irrigation (LSI) schemes have been managed by either nation and or state bureaucracies and by rigid, formal irrigation institutions. Under such structures, system management often fails to respond to the needs of users, particularly of smallholders. This is due to inadequate resources allocated to running and maintenance of LSI and their consequent deteriorating conditions, resulting to the introduce institutional reforms especially by the financing/donor agencies like the World Bank and Asian Development Bank in the eighties in the name of Participatory Irrigation Management (PIM), (Asian Development Bank 2012). In light of PIM approach, IWMI and

FAO have recommended a five pronged strategy for revitalizing Asia‘s irrigation (Mukehrji *et al*., 2009). Of these three strategies relate to PIM viz., modernizing irrigation systems both technically and institutionally, managing groundwater use, opting for public-private partnership, and providing incentives to irrigation officials in achieving better irrigation performance.

According to Wittfogel (1956) water supply and its irrigation networks over large territories originally gave rise to governments’ authority over large scale irrigation scheme. However, (Clough, 2003) say that there is no grain of truth in Wittfogel observations. By their very nature, large irrigation schemes have historically given rise to centralised agencies which could administer them. This exists even today: in many developing countries one can see that practically all the rural development projects of a certain size, especially where water is involved are initiated and often run by the central government. This made farmers’ to perceive large scale irrigation schemes as drought relief with high expectation of sustainable provision of agro support services and overall operation, maintenance and management of the system right from the head work to the field canals (FCs) and farm plots by the government. Pradhan (1992) and Haruna (2004) observed that majority of large scale irrigators perceived irrigation agency personnel as exploiters by pushing more system maintenance responsibly on them, despite that they are aware of farmers’ financial and technical weaknesses to shoulder those responsibilities. The most recent irrigation management reforms proved that management of irrigation system is never a one party responsibility thereforeit must be shared among its key stakeholders as presented in the table below.

Table 2:2 Role and Responsibilities of Stakeholders

| Farmer Group (WUAs) | Public Irrigation Agencies |
|---|---|
| ✓ Operation and Maintenance of Secondary Systems<br>✓ Enforcement of regulations<br>✓ Dispute Resolution<br>✓ Irrigation fees collection<br>✓ Cooperative formation and functions on behalf of its members | ✓ Enabling environment<br>✓ & M of Primary systems<br>✓ Regulatory role<br>✓ Research & Extension Support<br>✓ Foster agribusiness and farmers partnerships<br>✓ Irrigation and rural infrastructure |

Source: Adapted fromMusa (2009)

**2.8 Impact of Participatory Irrigation Management on the Livelihood of Water Users**

The commencement of PIM made farmers to appreciate the high cost of putting a scheme in place and that of operation and maintenance. They were then informed of the need for them to participate in operation and maintenance of the schemes for their own benefit. Despite the fact that their participation becomes very essential, some of the farmers were of the opinion that the Federal Government of Nigeria should continue to fund the RBDAs some welcomed the idea of the farmers getting involved in the operation and maintenance of the schemes.

Report by Review of Public Irrigation Sector of Nigeria (2004), has shown that most of the farmers reported that the operation of the schemes has had a positive influence on their life. However some of the farmers claimed their standard of living had declined badly since the large scale irrigation scheme divested from agriculture. Report furtherexamined the impact of the irrigation schemes on the farmers and communities in which they were located.

Variables examined include, the farmers income, the farm size, the standard of living as represented by the types of house they live in, the kind of food they eat, their mode of transportation, the kind of household items they possess. Variables examined for the impact on communities included, development of schools, health centres, mosques and churches, potable water and other social amenities.

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### 2.8.1 Empirical studies on participatory irrigation management

From an empirical standpoint, the phenomenal increase in the irrigation management transfer programmes due to the deteriorating condition of irrigation projects in Nigeria has generated a lot of research interest and interventions.Study (Tshuma,2009) showed the Best Management Practices (BMP) project of the Zonyokwe irrigation scheme in South Africa to have an impact on social and economic well-being of households. The project introduced was in the areas of water management, agronomic practices, marketing and institutional arrangements. The project outcome indicated that there was improvement in agronomic practices and water management and marketing. Also many farmers worked on their farms on a daily basis, which is a big change as none of the farmers worked during weekends before, and average time spent on the farms also increased from four to seven hours per day. The project also had a positive impact on social relationships and networks between farmers and the project team, as well as farmers and non-farmers. The increase in household incomes as a result of project had a positive effect on poverty and food security status of the beneficiary households. The project identified the proportion of households earning incomes that are below poverty line dropped from 61% to 38% within two years with considerable changes in the diet of the households.

### 2.8.2 Impact of participatory irrigation management on water users' livelihood

Tshuma (2009) indicated that majority of farmers acknowledged improvements in land use intensity. This was due to increases in acreage of crops and planting at both seasons (summer and winter). His finding also indicated that beneficiaries' economic well-being improved after the implementation of the irrigation management projects, in which farming made significant contributions to household income. The increase in household incomes had a positive effect on poverty status of households. Similarly, he opined that where irrigation management project was effectively implemented, the proportions of households earning incomes that are below poverty line significantly dropped to the minimum within few years of project implementation. His finding also shows that typically poor households dropped while the non-poor households increased from shortly after the project completion.

Majority of farmers indicated that they were more food secure than was the case before the implementation of the project. Changes in the diet of the households were noticed. In addition to the consumption of staples such as maize meal and rice, people added a variety of vegetables.

Similarly, under well organised programme of IMT, farmers were exposed to formal marketing as they were taken to formal markets as part of capacity building (Abubakar, 2009). As a result of this exposure, farmers improved their marketing system. More farmers became involved in contract marketing. They also put more effort to marketing functions such as group marketing and cooperative formation.

A study conducted by Madhusuda *et al*. (2002) in India, indicated that availability and access to irrigation infrastructure, coupled with the availability and access to new technologies- high yielding varieties and fertilizers, were major underlying factors for the success of the green revolution in India. They noted that better access to irrigation has facilitated intensification of cropping practices and inputs used, and contributed to the "modernisation" of the agricultural sector. Sisodia (1992) assessed the impact of participatory irrigation management on farm economy base on land use, cropping pattern, cropping intensity and yield levels of principal crops in two selected districts of Madhya Pradesh during 1982-83 to 1986-87. His finding showed that as a result of introduction of the programme, irrigation ratio had increased from 40.19 per cent in 1981-82 to 87.39 percent in 1986-87. The intensity of cropping showed a reasonable increase from 104.75 per cent in 1981-82 to 108.93 per cent in 1986-87. Murugesan and Parvathi (1994) in their study observed that after introduction of the participatory irrigation management approach which was accompanied by the formation of water users group at tertiary level, equity in irrigation water distribution of was maintained irrespective of reaches.

In the study carried out by Nizamedinkhodjayeva (2006) in Ferghana Valley of Central Asia a well-being of rural livelihoods was endangered by seasonality, indicating that non-vegetation season during winter and early spring was the most severe. This was explained by a more restrictive context to diversify livelihood activities by the rural poor. In addition to seasonal variations, rural households were threatened by floods or sudden frosts in spring and droughts in summer. To cope with such stresses and shocks as well as maximise and protect income, rural households pursued a number of strategies where irrigation water was one of the most essential inputs, such as: diversification of livelihood activities; reliance on

in-kind income and savings; and self-sufficiency in food. Most of the livelihood activities in the area were related to the irrigated agriculture: crop growing, poultry farming, livestock rearing and regular employment. The households with the most secure livelihoods were managing a number of small businesses simultaneously. There were also a few non-farming activities, such as brick-making, box-making, baking and selling bread or day-today self-employment outside the village. These non-farm activities were also indirectly dependent on access to irrigation water.

Smith and Sohani (1997) in their study on participatory irrigation management by land owners in Pakistan's lower Indus region opined that participatory management of irrigation was financially feasible but new drainage infrastructure was needed in order to deliver significant increases in output of water. Improvement in the equity of water distribution and determination of a basis for the sharing of drainage costs were the critical issues that needed to be resolved that could solve the problem of distribution of water. Belsare (2002) studied participatory irrigation management in Katepurna irrigation project in Maharashtra and established that it increased irrigated area from 2,000 ha to over 3,500 ha and drastically reduced water wastage in the year. The intervention increased the number of beneficiaries and improved crop yields. The approach was being tried in 25 projects within the Akola district where about 38 water user associations were formed and more water was being saved through the community water saving awareness programmes. Study has shown that, some of the farmers in Sokoto Rima River Basin Development Authority(SRRBDA) also claimed that they were able to perform the holy pilgrimage to Mecca because of the increase in their income as a result of irrigation farming. A number of the farmers stated that they were able to build houses as a result of earnings from their irrigated farms. In

Sepeteri (OORBDA) farmers reported that, they bought motorcycles, from the income generated from the irrigated farms, which was a sign of improved standard of living. Unfortunately, some of the farmers claimed their standard of living had declined badly due to the downturn on their income as a result of the non-operation of the scheme (RIPSON)

## 2.9 Empirical finding on Constraints to Participation and Operationalisation of Participatory Irrigation Management

An opinion surveys were conducted for different stakeholders in PIM to identify the constraints to the operationalisation of the concept. In one of the survey, Ganapathy (2008), showed that in the opinion of the farmers and their officials, political interference, paddy monocropping, poor coordination between Water User Cooperatives (WUCs) and Water Resource Department, non-cooperation among the farmers, low political will, lack of effective leadership, indifferent attitude of beneficiaries, in adequate awareness among farmers are the serious constraints to operationalization of PIM. Other related issues were lack of clarity in guidelines, insufficient training, low literacy level, inadequacy of funds, inadequate availability of water, untimely water releases, problem in mobilization of community and official apathy towards decentralization process. Farmers and officials opined that monocropping of paddy was a serious problem in the working of participatory irrigation management. It was also found that lack of coordination of WUCs and water resource department was another serious problem. Similarly, lack of leadership, awareness, motivation, training and non-cooperation among farmers was also a medium problem in the working of participatory irrigation management.

Reddy *et a.l* (2005) in their study observed that substantial amounts of money spent on the irrigation management reform process, was used mainly for improving the ailing irrigation systems rather than strengthening formal institutional structures. WUA's were promoted as non-political institutions, however, the elite captured the system and political involvement dominated their functioning. Decentralization of powers to WUA's had not taken place, as most of the important functions like assessment, collection of water charges and authorization of works remained in the hands of the irrigation department.

# CHAPTER THREE

# THEORITICAL FRAMEWORK

The literature reviewed have shown that the concept of participatory irrigation management and new institutional arrangement have a number of dimensions, span diverse disciplines and are related to various theories. This makes it necessary to separate them into different perspectives. Moreover, this study deals with concept such as strategic association of group with common aim and partnerships between the public and private sector, and the role of self-governing institution such as Water User Associations (WUAs). Having this in mind, this chapter will examine the theories and concepts relevant to the study such as Social change, Participation and empowerment, Social Impact Assessment (SIA) and Intervention Perspectives

## 3.1 Theory of Social Change

One inevitable thing in the life of all living creatures is change. When such alteration takes place in the line of interacting with human beings is termed as social change (Jibowo, 2000). Rogers and Shoemaker (1971) and Chitamber (1988) defined social change as the process by which change occurs in the structure and function of social system. The social system in this definition may be social group, a community, town, region or the nation. Therefore any change that occurs either as ideas, norms, value, roles and social habits of the people or in the composition or organisation of their society can be referred to as social change. When alteration occurs in rural social system, it is termed as rural social change, and such a change could be in all attributes of a societal unit such as number, quality and importance. The change could also be introduced from internal or external sources to the society or both. It could be planned or unplanned. Planned change involves direct human

intervention in directing change towards predefined goals like land reforms. On other hand, unplanned change happens suddenly as accidental change and is beyond human control e.g. flood or earth quake (Ekong, 2003). Social change could be by force, when it is quick with early gain but not enduring, or voluntary, when it is slow but enduring. It could be total if it is comprehensive or segmental when it affects a part of the system.

Different changes come to the notice of the rural population of the developing countries, including Nigeria. Introduction of large scale irrigation projects, use of machine in farming practices, application of agro chemicals to control weeds, pest, diseases and maintain/increase the fertility of the soil lead to the transformation of agriculture from peasantry to commercial in the country. In these instances, the study of irrigated agriculture revolves around the theory of social change because it must be based on the assumption that a project designed to increase agricultural production must resolve the issue of farmers' livelihood (Ega, 1988). In this regard, social change denotes planned change, the planned and deliberate entry into a situation to influence events and reduces undesirable occurrence (inventions), while the PIM is an intervention aimed at improving the livelihoods of beneficiary water users. In this study, impact implies outcome of the intervention to the beneficiaries' livelihoods. This theory therefore, provides a framework for understanding the social changes that have taken place in the lives of beneficiaries (water users') specifically to their income generating activities, access to adequate irrigation water crop yield and food security.

### 3.2 Theory of Participation and Empowerment

During the 1980s and 1990s, there was a switch from the top-down approach in rural development, marked by external technologies and nation-level policies, to a bottom-up grassroots approach (Ellis and Biggs, 2001). People-centred development, which involves participation of the majority of the people, especially small-scale farmers, was now viewed as the most important factor for successful agricultural/rural development projects (Roodt, 1996). He defined participation as autonomous and meaningful involvement of people to a greater or lesser degree in organisations indirectly or directly concerned with decision-making about, and implementation of development projects. The concept valued the consciousness and experience of project beneficiaries and efforts made to involve them in development projects (Warburton, 1998). Human consciousness and experience of the rural poor are now being embraced by acknowledging local knowledge in development projects. The recognition is that community members have intimate knowledge of their problems and have creative and practical solutions to addressing these needs (Hill *et al*., 2004). Therefore, the rural people should be consulted as they, more than anyone, know the extent of their situation. Consequently, decision-making should be decentralised allowing the community to decide the best strategy for local development (Narayan *et al*., 2000). This implies that if communities are appropriately empowered, they can often manage their own local development efforts. It is assumed that such participation and empowerment initiatives will ensure that projects bring lasting change, and thus, sustainability (Warburton, 1998). These lead to sustainability of development projects and rural farmers earn their livings in diverse ways.

## 3.3 Conceptual Frame Work

### 3.3.1 Socio-economic impact assessment (SEIA) concept

Impact Assessment (IA) is defined as "a process of systematic and objective identification of the short and long-term effects–positive and negative, direct or indirect intended or unintended, primary and secondary–on households, institutions and the environment caused by on-going or completed development activities such as a program or project." An IA helps researchers in development to better understand the extent to which activities affect the poor, which objectives are fulfilled, and the magnitude of their effects on people's welfare. An IA evaluates the effects of the different stages of an innovation system or intervention, from Research Inputs, Research Outputs, Outcomes and Final Impacts (Michael, 1984).

The IA should provide information and results that are credible and useful, enabling lessons learned to be used for decision making by all stakeholders (Tshuma, 2009). Impacts are the broader, longer-term, economic, social, or environmental effects resulting from research or development interventions. Evaluation is a systematic and objective process of judging, appraising, or assessing the worth, value, or quality of interventions in terms of their relevance, efficiency, effectiveness, and sustainability, as well as impacts. Linkages exist between the two terms and practices, and several elements and results of an IA can be used for the purposes of evaluation, but there is a clear distinction between the two.

According to Alene *et al.* (2006) impact assessment of agricultural research is viewed as an important activity to ensure accountability, maintain credibility and improve internal decision-making process and the capability to learn from the past experience. Impact assessment is seen as a critical component of agricultural research that helps to define

priorities of research and facilitate resource allocation among programmes, guide researchers and those involved in technology transfer to have a better understanding of the way new technologies are assimilated and diffused into farming communities, and show evidence that benefit from the research products (Manyoung *et al*., 2001).

This study made use of the Socio-Economic Impact Assessment (SEIA) framework to assess how the PIM intervention introduced in KRIP has impacted on the lives of the farmers both socially and economically. In this sub section, the SEIA concept is reviewed, starting with the theoretical definition and reviewing the framework used to analyze the social and economic impacts. The variables and key indicators used in this SEIA are also identified and the benchmarks for determining the impact of the entire project in the farmers‟ lives are set by means of a framework for analysis.

A socio-economic impact assessment (SEIA) examines how a proposed development will change the lives of the communities targeted for development. SEIA is a framework for analysis which is divided into three phases, viz, scoping, baseline profiling and assessing the impacts.

**Scoping**

The purpose of scoping is to determine the focus, scope and content of the SEIA, the initial assessment of the potential impacts, possible mitigating measure and monitoring programmes. Thus, this phase of SEIA establishes and sets the extent or boundaries within which the whole assessment would be carried out especially by focusing on only the key

impacts. The Bureau of Rural Sciences (BRS) (2005) identified the important aims of scoping as determining the:

(i) time and resources available for the SEIA

(ii) nature of the proposal being assessed

(iii) groups who are potentially impacted

(iv) key impacts of interest

(v) extent of available information, its potential usefulness in terms of appropriate scale, timeframe, content etc and how data gaps can be addressed

**Baseline profiling**

This phase follows the scoping phase and is also equally important in carrying out a SEIA. In this phase/stage, the historical context and current status of the impacts under which the project is undertaken are explained. Regarding the PIM project, profiling was done in 2005 by the ADENI team, through a collaborative effort with NAERLS, HJRBDA and the irrigation farmers'. However, a similar report of base line from control group Watari Irrigation Project (WIP) was not available and as such only with and without (cross sectional) impact study method was employed. Despite the non usage of base line report, it is still important to highlight how it could be done. The aim of baseline profiling is to create the understanding of the socio-economic conditions that existed prior to the implementation of the project as these would act as the benchmark for determining the extent of the changes brought about by the project (BRS, 2005). In this sense, these baseline conditions should cover the attitudes of water users' toward irrigation management, social conditions, economic and financial background and population characteristics.

**Assessing the impacts**

Following the baseline profiling phase is the actual assessment of the impacts of the entire project. This phase is done towards project completion and involves comparing the situation before project implementation (using baseline data) and after its implementation to identify any variations between the two scenarios. It is only after assessing the existence/non-existence of changes that solid conclusion regarding the contribution of the implemented project to the targeted community can be deduced (DEAT, 2006). Since by the time of assessment not all impacts would have been experienced, then predictions are also used especially to assess expected future impacts. The socio-economic impacts in this framework are divided into two, the direct and indirect impacts.

**Direct impacts**

The Inter-organizational Committee (1994) referred to the direct impacts as those impacts that are usually felt by the participants in the project, be it individuals, groups and firms that are directly engaged in the activity being affected. In this case, the term "direct impact" was used to refer to the impacts felt by the water users who are the beneficiaries of the PIM project together with their families. Ideas pertaining to such impacts were obtained from those identified as potentially affected by the activity where possible over a period of time, and this data were in turn used to establish a baseline level and rate of change in key variables. The direct socio-economic impacts were also used as the variables when assessing the impacts of a project. The data on these impacts were collected using the primary and secondary sources. In the case of primary data, the people who feel the impacts can be asked for their opinions, attitudes, beliefs, experiences and reactions pertaining to the impacts from the project through a survey or focus group meetings.

**Indirect impacts**

The Inter-organizational Committee (1994) defined the indirect impacts as those that often occur later after the direct impact. In other words, they emanate from the direct impacts. It is not an easy thing to separate the indirect from the direct impacts but the former usually occurs at a broader level as a result of the individuals or groups directly associated with the effect of the latter. In this sense, it is no surprise that the indirect impacts can include direct impacts such as income. Just like with direct impacts, data on the indirect impacts were obtained through surveys, focus groups and the secondary data sources. These impacts factors including age, employment, length of residence and other demographic characteristics suggested by the BRS (2005) influence changes to: employment and income in a project region, population in levels of service provision and social capital in a community/region.

### 3.3.2 Approaches to impact assessment

#### *3.3.2.1Conventional approaches*

Conventional project evaluation usually focuses on assessing whether a project has met its stated (log frame) objectives and contributed to the achievement of the overall project goal. It uses criteria of project relevance, efficiency, effectiveness, impact and sustainability and looks at both intended and unintended impact. Analysis takes place at set points during the project cycle: during project implementation (mid-term review); at project completion; and several years after completion (ex-post evaluation).

Impact assessment is usually conducted by outside experts. The team tends to work with the indicators that were defined at the start of the project, seeking to collect quantitative

data to ensure ‘scientific objectivity’, comparability and statistically valid samples (though qualitative data collection techniques and checklists are also used). Conventional methods therefore tend to create a degree of distance between those assessing impact and project participants/beneficiaries.

Impact indicators used in conventional conservation impact assessment tend focus on cash/economic issues, because these are considered key to creating incentives for conservation combined with biophysical indicators (e.g. changes in vegetation, wildlife populations).

#### *3.3.2.2 Participatory approaches:*

Participatory monitoring and evaluation (PM&E) is emerging as an alternative to conventional approaches. PM&E makes use of a range of techniques, tools and approaches to assess the impact of development activity (Estrella and Gaventa, 1998). It involves ‘local people, development agencies, and policy makers deciding together how progress should be measured and results acted upon’ (IDS 1998), allowing intended beneficiaries to contribute to the definition of project ‘success’. Indicators are developed through a consultative process with all actors and all are involved in data collection and analysis. Indicators may be both qualitative and quantitative, but PM&E relies to a great extent on qualitative judgements made by local people and project staff rather than on the interpretation of quantitative data by outside experts. Some feel this does not impart enough neutrality to the analysis as villagers selectively share knowledge and speak for their own purposes and objectives.

#### *3.3.2.3 The livelihoods approach*

The livelihoods approach differs from conventional evaluations in its central focus on people's lives rather than on resources or defined project outputs. As we have gained an improved understanding of poverty in recent years, three key facts have been highlighted. First, well-being is not only about increased income. Other dimensions of poverty that must be addressed include food insecurity, social inferiority, exclusion, lack of physical assets, and vulnerability. Second, household poverty is determined by many factors, particularly access to assets and the influence of policies and institutions. Third, livelihood priorities vary; outsiders cannot assume knowledge of the objectives of a given household or group. Project impact assessment must therefore be based upon a prior understanding of people's objectives as well as on an informed view of how their livelihoods are constructed and which factors are the essential causes and manifestations of their poverty.

SEIA was applied to the study of impact of PIM on WUs' livelihoods. Irrigation management is multi-dimensional in its nature and it touches the entire welfare of WUs. This study therefore attempted to make an in depth evaluation of PIM to see whether it influenced the livelihood of WUs in KRIP and from the result of the study it was revealed that livelihood of WUs in KRIP has improved.

### 3.3.3 Intervention perspectives

Intervention Perspective is employed in social studies and social policy to make effective decision on problems situation in order to secure desired outcomes, Lloyd Pye is the world's leading proponents of the perspective. For any intervention to be accepted and sustainable the immediate beneficiaries' attitudes need to be changed more especially if it

has constraints tendencies on the existing project. There are steps in achieving sustainable changes. One among them is the formulation of concept of intervention (Diana, 2005).The concept of intervention lays out the plan for exercising influence. Ideally it specifies the agents (who should intervene), the target (whose actions are to be changed), the mechanism (how to intervene) and the time and place (when and where an intervention takes place). Identifying the agents of intervention can be difficult for foundations and for governments. Agents of intervention are assumed to have the power and the capability/resources to intervene. In reality, choice of such agents may be limited, not least by existing structures and distribution of power and resources. Selection of targets, those whose actions are to be changed also presents problems. When targets are powerful, numerous and heterogeneous it is likely to be more difficult to find a way of getting all of them to change, and the costs are likely to be higher than when the targets are small in number and/or homogeneous.

Moreover, if the target actors themselves have limited control over their behaviour, developing an effective perspective of intervention may also be difficult. In some cases, for example, it may be necessary to target and or change structures and practices.PIM was an intervention which deliberately entered into the irrigation management situation to influence the performance of both irrigation infrastructures and WUs. This study was able from the finding of the result that participation of WUs in PIM implemented irrigation scheme improved their livelihood outcomes when compared to control irrigation scheme which was inadequate in terms of performance of irrigation infrastructures.

### 3.5 Conceptual model of factorsinfluencing water users' participation in PIM intervention and its impact on their livelihood outcomes

According to Alkin (1970) a model is simply "an attempt at classifying the major elements of an entity or a phenomenon with regards to their function and interrelationships in order to observe more closely how the elements function within the entity, how they enable it to operate and how they act upon one anther". These relationships can be depicted schematically or mathematically (Asika, 2006)

In developing a model for this research, an attempt was made to integrate the theories and findings of some experts. These include those of Rogers and Shoemaker (1971), Moore (1963), Neehan (1931) and Ekong (2003). In water sector, livelihoods analysis is essential. Firstly, it builds on better understanding of multiple perspectives and values water as economic capital (agricultural input, domestic needs), physical capital (irrigation infrastructure), managerial and institutional capital (water users' organisation), social capital (collective action) as well as political capital (Ashley and Carney, 1999, cited in Nicol, 2000). Emphasis in the model (figure 1) was placed on irrigation management (maintenance and operation), training, mobilization, facilitation of farmers with water users' groups, marketing and input procurement, conflict resolution among water users, Collection of water dues from farmers and how these services provided affected the water users' in KRIP.

In this research work it was identified that accessibility of PIM intervention impacted on the livelihood outcomes (assets procession, increase income and crop yield from irrigated farming, access to adequate water and increase food security) of the water users (Figure 1).

Therefore, confounders (socio-economic characteristics) such as age, educational level, farming experience, farm size, farm reach/location, access to irrigation water, EA/agency staff contact, member ship in WUAs, and the project intervention variables such as WUAs formation, increase acreages, decision making, conflict resolution, Payment and collection of water charges, maintenance of primary and secondary structures constituted confounding and intervening variable.

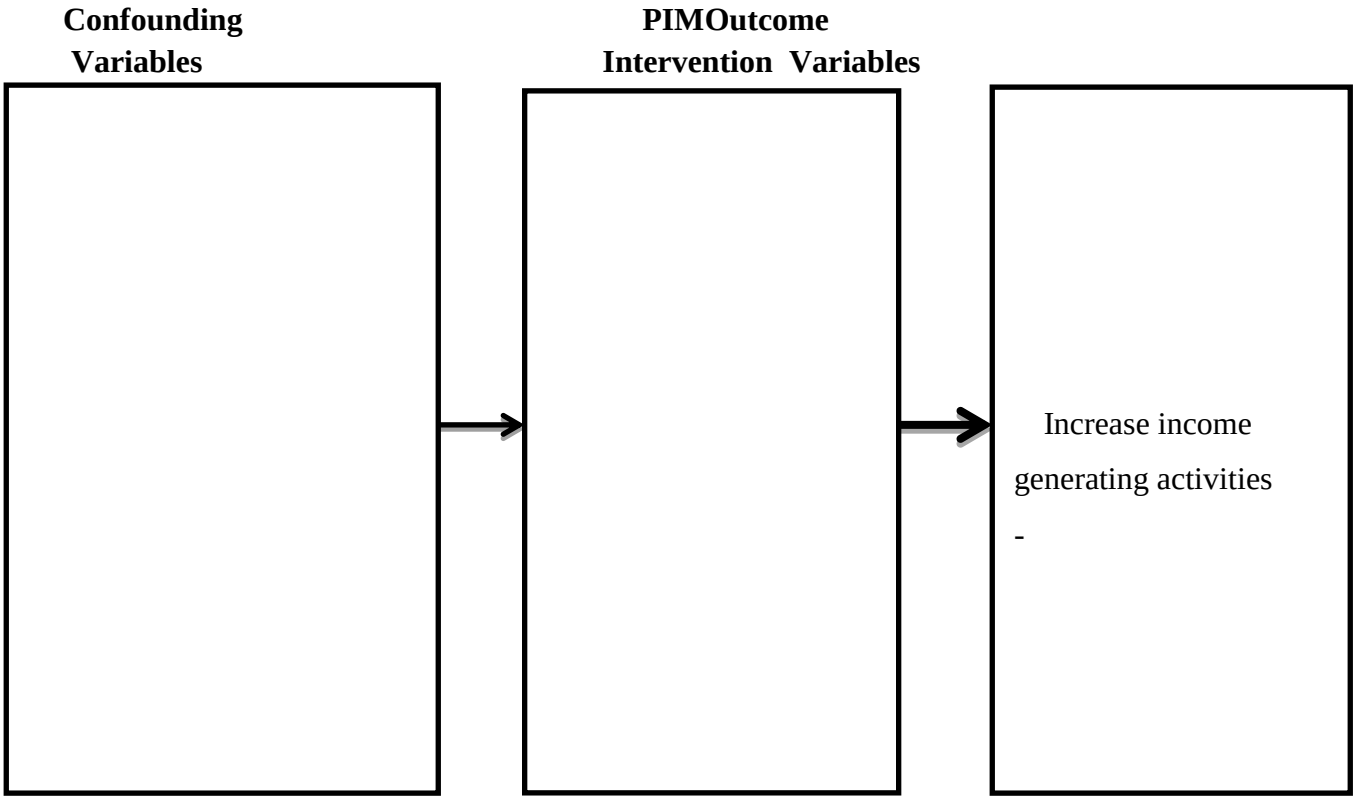


Figure 2: A conceptual model showing Confounding (Socio economic) Factors of Water Users' Participation in PIM intervention and its impact on their livelihood outcomes, as adapted from Kossak (2014).

# CHAPTER FOUR

# METHODOLOGY

The study employed a survey research design to collect socio-economic data amongst irrigation farmers. The situation analysis, which was conducted amongst the respondents PIM implemented and non PIM implemented (with and without the intervention) communities allowed a comparisons in order to track changes or impacts after the implementation of the project. Also, the social and economic impact assessment (SEIA) framework was used to assess the impact.

## 4.1 Description of the Study Area

The study was conducted in KRIP and WIP Kano State, which is positioned in Northwestern Nigeria (Figure 2). Whereas Kano River Irrigation Project (KRIP, lies between latitude $11^{o}45`$ and $12^{0}05`$ North of the equator and longitude $08^{0}45`$ and $09^{0}05`$ East of the greenwhich mean. It is located at a vast area over 25Km south of Kano city and it is essentially most of irrigable land on both sides of the Kano - Zaria highway and on both sides of the Karfi – Rano highway (Figure 3). It is a scheme design to provide irrigation facilities for about 22,000 hectares of land utilizing the Tiga Dam Reservoir (Shariff, 2009).

The main goals of KRIP are improvement of food security and effective management of water resources for the development of socio-economic activities of the people within the basin. Other objectives aimed to achieve the goal(s) above are:-

1) Provision of water resources for domestic, industrial and recreational uses,
2) Provision of employment in both agriculture and agro- industries,

3) Facilitation of fisheries and hydro-electric power generation,
4) Improvement of the standard of living of the basin's inhabitants,
5) Source of income to the government,
6) Flood control in the Hadejia valley,
7) To support large scale crop production to meet the steadily increasing population.

In KRIP, the crops and cropping intensity in irrigated fields increased for the two growing seasons above non-irrigated fields when compared. Rice is the most common crop. During the wet season, rice is cultivated on more than 5000 ha (40%) of the total irrigated area of about 12,500ha. Due to high market prices, rice has replaced other traditional and more suitable crops, such as groundnuts and other pulses. Because of the rice irrigation regime, soils are subjected to continuous saturation and high groundwater table. During the dry season, wheat, being cultivated on about 4700 ha (35%) of the irrigated area, is the most common crop, with maize and vegetables as the other dominant crops. The introduction of rice and wheat to the project area has undoubtedly been the incentive for local development, and has largely contributed to the move from the previous subsistence economy to the now prevailing market oriented economy (Shevah, 1993).

On the other side the Watari Irrigation Project (WIP) was used as control and it is located in Bagwai Local Government Area in Kano State (Figure 3). The project is situated at Latitude of $12.2^0$N and Latitude $8.3^0$E in the valley of the Watari River, which is a tributary of Challawa River. The Watari irrigation project has potential irrigation areas of 1,365ha out of which 691ha have been developed. Surface Irrigation method is practiced in thedeveloped area through gravity system. The Project has eight sectors (water unit areas)

in which only five sectors have been completed (Usman 2001). The Watari Irrigation scheme was built and managed by the Kano State ADP is smaller than the KRIP scheme. It was selected because of its proximity to KRIP and resemblance of functional WUAs and opportunitiesfor comparative assessment though; the CIRAD/HJRBDA/NAERLS intervention did not cover the scheme.

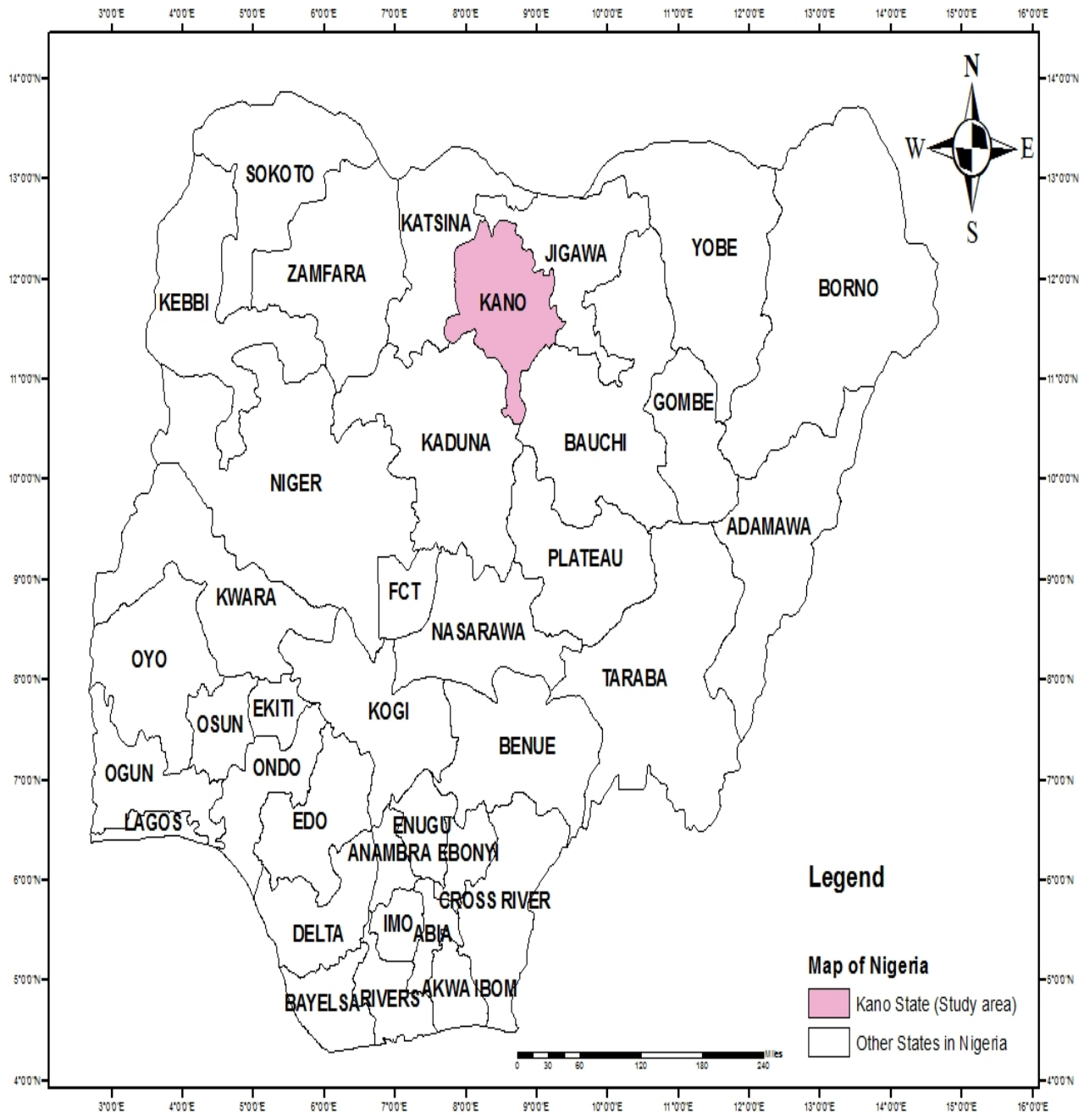


Figure 2: Map of Nigeria showing Kano State

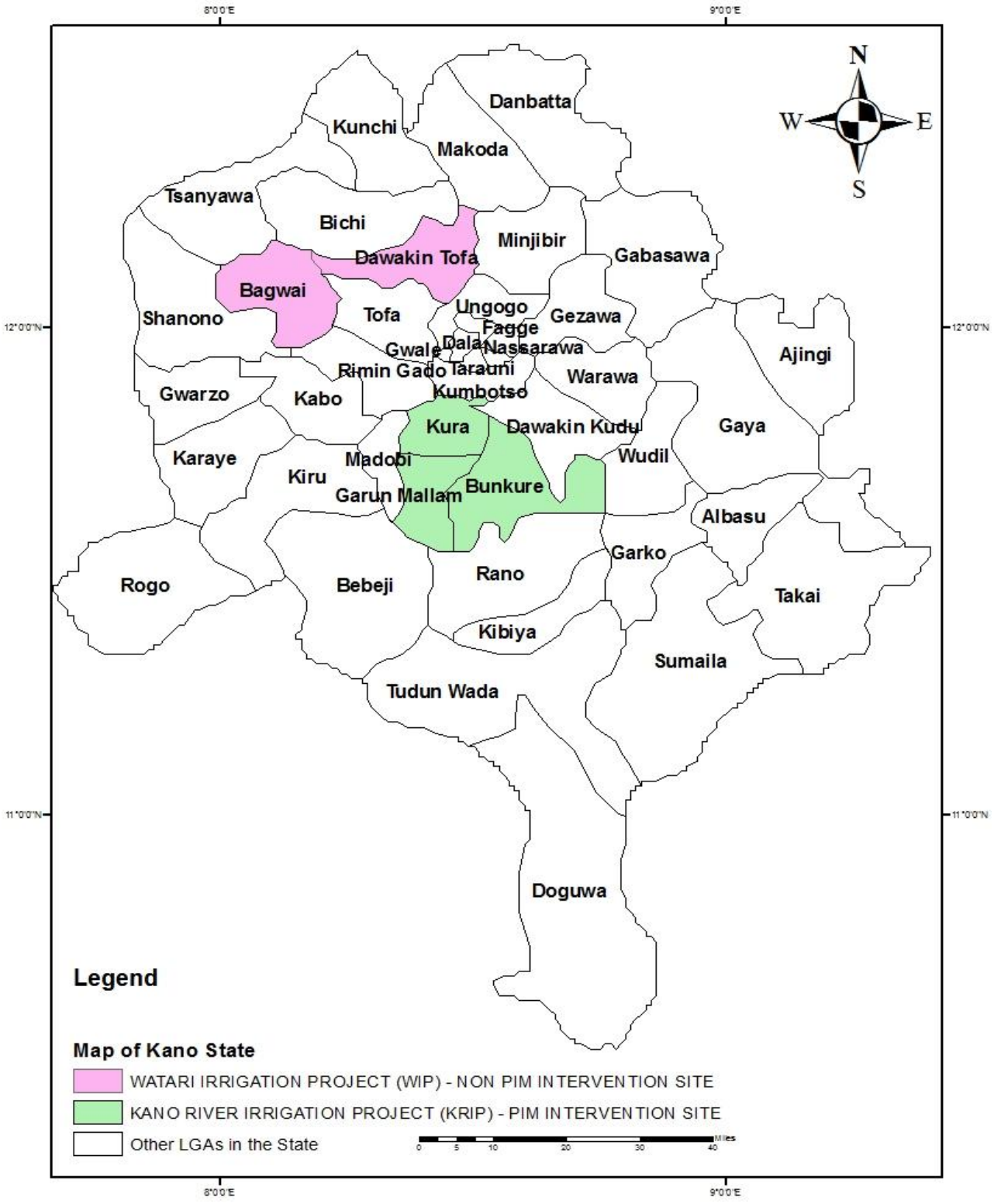


Figure 3: Map of Kano State showing KRIP (PIM intervention site) and WIP (as comparison site)

### 4.2 Description of the Intervention

For the effective takeover of Participatory Irrigation Management (PIM), certain process and methods has to be followed. Among which are: sensitization, mobilization, legal frame work, development of operation and evaluation.

The first to vet for the implementation of PIM is the creation of awareness for water users to understand what the concept is all about. Awareness creation could only be done through sensitization meeting between farmers, irrigation and PIM intervention agencies. The sensitization exercise encompasses training workshops for irrigation agency and water users, formation of farmer into water user associations (WUAs) and study to tour expose the expected beneficiaries to PIM implemented irrigation schemes within and outside the country.

The second aspect is the development of legal framework for PIM stakeholders to understand responsibilities and limitations on irrigation management. These responsibilities sharing among the stakeholders can only be actualizing if enabling environment is adequately provided. The third step is the development of guidelines for the operation and maintenance of irrigation facilities/infrastructures, where information on O&M problems would be identified to proper solutions.

The final stage is the evaluation which entails the monitoring and evaluation, physical improvement, collection of water charges, linkages for inputs procurement, saving irrigation time/equity in water sharing among water users, diversify cropping patterns and organizing marketing strategies (Anonymous, 2001)

Table 4.I: Type of intervention on different aspect of Irrigation Management

| Type of Interventions | Intervention mode |
|---|---|
| Sensitization of WUs Into WUAs | Sensitization and facilitation of farmer to form water users' group |
| Management. of Irrigation Structures | Training/Workshop on how farmers could manage irrigation infrastructures. |
| Conflict resolution among water users | Enlightenment Workshop on how farmers can resolve conflict. |
| Conflict resolution between water users' and pastoralist | Enlightenment Workshop on how farmers and pastoralist can resolve conflict. |
| On farm Crop and Soil management | Training/Workshop on how farmers can properly manage their farm. |
| Collection of water dues from farmers | Facilitation and training of water users on how they can collect and pay water dues to agency. |
| Input procurement and Marketing of Farm produce | Cooperatives/Group formation and group marketing of produced |

Source: Adapted from Abubakar 2009

### 4.3 Sampling Procedure and Sample Size

Multi-stage sampling technique was used for the study. The first stage involve purposive selection of LGAs covered by gravity irrigation projects. The second stage involves the selection of two irrigation villages each from three (3) LGAs that cover PIM implementation areas, thus making a total of six (6) villages. They were: Shiye and Lautaye, in Bunkure LGA, Agalawa, Garun-Babba in Garun-Malam and Bugau and Karfi in Kura LGA. In order to study the impact of PIM, six (6) villages in Watari Irrigation Project (WIP) where PIM is not introduced as control group were also selected to compare the impact of PIM. The control villages comprises of Janruwa, Kauyan Adam and Soki da bula from Bagwai LGA. While Bauje, Jobe and Unguwar-Rimi from Dawakin-Tofa LGAs.

The third stage involves systematic random sampling of 10% water users from the list of 5959 water users. In all, five hundred and ninety three (593) water users' were selected and used for the study as shown in the Table 4. In order to identify the constraints to effective participation and operationalization of PIM, 36 WUAs' officials and 12 irrigation agency staff with adequate experience in irrigation management within the selected villages were purposefully selected, using snow ball sampling techniques to elicit their opinions. The reconnaissance survey was carried out to identify the sampled villages and WUs.

Table 4.2: Sampling Procedure and Sample Size

| **S/No** | **PIM Implemented Irrigation Scheme** | | | **Non PIM Implemented Irrigation Scheme** | | |
|---|---|---|---|---|---|---|
| | **KRIP** | ***Sampling Frame** | **Sample Size (10%)** | **WIP** | ***Sampling Frame** | **Sample Size (10%)** |
| 1. | Agalawa | 472 | 47 | Bauje | 396 | 40 |
| 2. | Bugau | 499 | 50 | Janruwa | 496 | 50 |
| 3. | Garun Babba | 668 | 67 | Jobe | 307 | 30 |
| 4. | Karfi | 802 | 80 | Kauyan Adam | 574 | 57 |
| 5. | Lautaye | 273 | 27 | Soki da Bula | 413 | 41 |
| 6. | Shiye - Gari | 539 | 54 | Unguwar Rimi | 520 | 50 |
| **Total** | | **3253** | **325** | | **2706** | **268** |

### 4.4 Method of Data Collection

The study used primary data obtained from water users in the study areas. The data were collected with the help of enumerators which were trained from 24$^{th}$ to 29$^{th}$ May, 2015. The structured questionnaires were administered between the months of June and July, 2014. The information collected included socio-economic characteristics of KRIP and WIP water users and their perception on the roles of WUAs officials and irrigation agency staff

towards irrigation management sharing and users and improvement in the performance of irrigation infrastructures as well as the impact of participatory irrigation management on the water users' livelihood outcomes. Regarding the performance of the scheme, thisstudy, measured it in both qualitative and quantitative terms, as suggested by. Giordano, *et al*. (2006) in a similar research conducted to assess the outcomes of International Water Management Institute (IWMI) research and interventions on irrigation management transfer in Colombo, Sri Lanka. The qualitative assessment is based on farmer perceptions of changes in selected performance indicators after intervention. The quantitative analysis is based primarily on the standard set of indicators formulated by IWMI to assess the performance of irrigation schemes (Molden *et al*., 1998).The indicators relate to financial, agricultural, hydrological, and socio-economic performance across irrigation systems. The specific indicators used to assess performance and the level at which they were measured are set out in Table 5. The data on constraints to participation and operationalization of PIM were also collected. The performance indicators were also developed to study the performance of water user's association and irrigation agencies in both PIM and non PIM implementation areas.

Table 4.3: Performance indicators and the level at which they are measured.

| Performance indicators | Scheme level | Farm level | Data source |
|---|---|---|---|
| **Financial performance indicators** | | | |
| Irrigation cash costs per hectare to the farmers | | X | Farmer survey |
| Money collected from water users and remitted to agency | | X | Farmer survey |
| Total irrigation costs per hectare to the farmers | | X | Farmer survey |
| **Operational performance indicators** | | | |
| Farmer perceptions about O&M responsibilities | | X | Farmer survey |
| **Maintenance performance indicators** | | | |
| Percentage of structures that are fully functional, partly functional, and dysfunctional after the intervention | X | | Field inspection |
| Farmer level of participation in canals, drainages and other infrastructures maintenance | | X | Farmer survey |
| **Agricultural performance indicators** | | | |
| Cropping intensities by season. | | X | Irrigation agencies |
| Yield of major crops by season | | X | Irrigation agencies |
| Farmer perceptions about changes in irrigation management responsibilities | | X | Farmer survey |
| **Economic performance indicators** | | | |
| Total income | | X | Farmer survey |
| Farmers other income generating activities | | X | Farmer survey |

### 4.4.3 Validity of the instrument

Content validity measures how well the content of an interview schedule or questionnaire meant to obtain the information required for investigation (Patel and Antonio, 1974). Also Chuta (1992) described content validity as a way of determining the relevance and suitability of items needed in a questionnaire or interview schedule. Going by the rationale behind content validity, the final instrument developed for this research was then subjected to content validity to be certain that it measures what it is require to measure. This was done by giving out samples of the interview schedule to experts; my supervisors, statistical

analyst and some lecturers in the department of Agricultural Economics and Rural Sociology. This is in conformity with Kerlinger (1977) agreement that validation of an instrument by experts is important.

### 4.4.2 Reliability of the instrument

Reliability is defined as the degree of accuracy with which an instrument, test or set of tests measures whatever it is measuring. It also has to do with consistency and stability of the instrument or test. To ensure that the instrument developed for the data is reliable, the validated questionnaire will be administered to thirty (30) water users' which comprises of fifteen (15) from PIM implemented communities and other fifteen (15) from non PIM implemented communities from both KRIP and Watari irrigation scheme. The first questionnaire was administered to the respondent, and after collection of the filled questionnaire, three to four weeks interval the second questionnaire was administered to the same respondents. Two score for each questionnaire collected was correlated; this is called test- retest reliability. The correlation coefficient was calculated to determine whether there was relationship between the test score and retest score (Okeh, 2010). The correlation coefficient will be calculated using the formula $\mathrm{r} = \frac{1-6\varepsilon d^2}{N3-N}$

Where: r = correlation coefficient (spearman Rank)

$\sum d^2$ = Total of all subjects squared scores differences

N = number of paired score.

According to Denga (1987) any reliability coefficient above 0.6 is acceptable as reliable coefficient of the instrument. The two coefficients of stability can be approximated to one (1) which implies that the instrument is reliable and internally consistent

### 4.5 Analytical Techniques

The impact analysis used both descriptive statistics and inferential statistics. Descriptive statistics was applied to organize, summarize and analyzed the data collected. Inferential methods, such as multiple regression and Propensity Score Matching (multi stage analysis involving logistic regression and independent t-test) were employed to quantify important empirical results. The following tools of analysis were employed to achieve the objectives of this study.

#### 4.5.1 Descriptive statistics

Descriptive statistics techniques that were used to describe the collected data include mean, standard deviation and mean rating. Since descriptive statistics shows the clear picture of socio-economic and socio-demographic situations of respondents, it was used to achieve objectives i. describe the socioeconomic characteristics of water users in the study area, ii, assess the extent of water users' involvement in the management of irrigation system, iii. examine the level of water users' income sources and crop diversification,

v. ascertain the water users' level of perception of WUAs officials and irrigation agencies roles effectively played in the management of irrigation system and vii. to describe the constraints encountered by PIM beneficiaries water users.

#### 4.5.2 Multiple regression models

This study utilised multiple regression model to empirically quantify the relative influence of various factors in the decision of the water users' participation in PIM intervention (objective iv) of the study. The equation for multiple regression models is as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + b_{11}x_{11} + U \quad \ldots\ldots \text{(i)}$$

Where:

Y= Participation in PIM intervention (the composite score of WUs' participation in PIM)

$x_1 =$ Age (years of respondents)

$x_2 =$ Level of education (Years of schooling)

$x_3 =$ Household size (Number)

$x_4 =$ Farming as major occupation (1= for WUs who reported farming as their main occupation and 0= otherwise).

$x_5 =$ Years in irrigation farming (years)

$x_6 =$ Membership of water users association (WUAs) (1= member and 0 = nonmember)

$x_7 =$ Extension contact (number of contact per year)

$x_8 =$ WUs' perception on irrigation agency role in O&M (very effective 5, effective 4, no opinion 3, less effective 2 and not effective 1)

$x_9 =$ Land ownership patterns (Actual Ha own through; inheritance = 5, purchase = 4, rent =3, share cropping = 2 and lease =1)

$x_{10} =$ Total size of farm land use for irrigation (number of Ha put under cultivation)

$x_{11} =$ Farm locations (3= top, 2=middle and 1= tail end of irrigation scheme)

$b_1 - b_{11}$= Regression coefficient

U = Error term

### 4.5.3 Measurement of water user food security status:

Food security index (FSI) is a derived variable obtained by identification and aggregation procedures. The food security line used in this study was based on the daily-recommended level of calorie and protein requirement, which are 2260 Kcl and 65 respectively. In order to generate this food security index, the nutrient content of the food consumed was used to derived both calorie and protein availability. The formula used was as follows:

$$\text{FSI (Zi)} = \frac{\text{Household daily per capital calorie/protein (kg) consumed}}{\text{Household daily per capital calorie/protein (kg) required}} (x)/(y) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

For the water user to be food secured Zi must be greater than or equal to 1 (Zi > 1). If Zi is less than 1 (Zi<1) the house hold is food insecure. The quantity of food crop produced and purchased was converted to kilogram and further to calorie was divided by the adjusted house hold size and by 365 days to obtain the calorie and crude protein consumed per day per house hold and then compared with the standard (2260Kcl and 65 gram) respectively. A kilogramme of food items predominantly consumed by WUs were purchased and nutrients equivalent value as provided by FAO was used to calculate the approximate consumption of WUs per day.

**4.5.4 Propensity score matching analysis**

Propensity Score Analysis is a statistical tool which was used to measure the potential impact of intervention between two groups (participating and non-participating water users). The model requires information from both groups after the project implementation to compare its impact. It was employed to achieve part of objective vi (determine the impacts of PIM on the livelihood outcomes of water users). The model is presented below:

$$ATE1 = \left[ \sum_{i \in T} y1ij - \sum_{i \in u} \omega(i,j) y0ij \right]$$ ---------- (iii)

Where

$ATE_1$ = Impact of participation in PIM intervention on WUs

$n_T$ = Number ofparticipating WUs

$y_1$ji=Livelihoods outcome of participating WUs

$y_0$ji=Livelihoods outcome of non-participating WUs

$\omega$(i,j) = Weight

j = WUs identifier = 1,2,3,…… 325

Propensity score using Mahalanobis distance matching (MDM) procedure is built on specific notions of distance between observations of treatment covariates (Austin, 2009). MDM measures the distance between the two observations Xi and Xj with the Mahalanobis distance,

$$M(Xi, Xj) = \sqrt{(Xi - Xj)\, S - 1\, (Xi - Xj)},$$

where S is the sample covariance matrix of X. In PSM, the first step is to collapse the vectors to a scalar "propensity score," which is the probability that an observation receives treatment given the covariates, usually estimated by a logistic regression, πi ≡ Pr (Ti = 1|X) = 1/(1 + e Xiβ ); then, the distance between observations with vectors Xi and Xj is the simple scalar difference between the two estimates π̂i − π̂j (or sometimes Xiβ − Xjβ). It was used to evaluate the overall average of PIM intervention impact on the livelihoods of water users

***4.5.4.1Logistic Regression***

Logistic Regression Analysis (LRA) extends the techniques of multiple regression analysis to research situations in which the outcome variable is categorical. The model for logistic regression analysis assumes that the outcome variable, is categorical, example dichotomous, but LRA does not model this outcome variable directly. Rather, LRA is based on probabilities associated with the values of the output. Generally, logistic regression is well suited for describing and testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables (Peng*et al.*, 2002). The logit model, which is based on cumulative logistic probability functions, is computational easier to use than other types of model and it also has the advantage to predict the probability of farmers adopting any technology. Unlike the Multiple regression and Discriminant analysis which poses difficulties when the dependent variables have only two values, 1 if the event occurs and 0 if it does not (Karki and Bauer, 2004), the Binary Logit Regression Model (BLRM) is considered appropriate in such a situation (Polson and Spencer, 1992). It requires far fewer assumptions than multiple regression, even when the assumptions required for Discriminant analysis are satisfied and still performs well (Hosmer and Lemeshow, 1989; kleinbaum 1994).

According to Gujarati (2004) binary logistic regression is applicable to a broader range of research situations and it is able to predict the presence or absence of a characteristic or outcome based on values of a set of predictor variables and it is similar to a non-linear

regression model but is suited to models where the dependent variable is dichotomous. There is flexibility in the model where independent variables can be interval level or categorical; if categorical, they should be dummy or indicator.

Estimating the propensity score between the water users who participate in PIM and those who do not was achieved using binary logistic regression model. The model assumes that the underlying stimulus is a random variable which predicts the probability of water users' participation in PIM. The relationship between the independent variable and probability is non-linear. The probability estimate will always be between 0 and 1 (Karki and Bauer, 2004), regardless of the value of Z in equation 5. This study utilized logistic regression model to empirically quantify the relative influence of various factors in the decision of the water users' in PIM participation. This was estimated by using the maximum-likelihood method, that is, the coefficients that make the observed results were selected. The relationship of this dependent variable was examined with the independent variables in equation vi.The logistic regression model which estimates the probability that observation receive treatment given the covariates is specified as follow:

$$\ln Y\left(\frac{PS}{1-PS}\right) = \beta_0 x_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_n x_n \quad \ldots \text{(iv)}$$

$$ps = \frac{e^{\beta_0 x_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_n x_n}}{1 + e^{\beta_0 x_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_n x_n}} \quad \ldots\ldots\ldots\ldots (\text{v})$$

Where:

LnY = Log of residual of the dependent variable Y .

Ps = Propensity of outcome where $Y_S = 1$

1-Ps = Propensity of outcome where $Y_S = 0$

$X_1$ = Years of PIM intervention (years)

$X_2$ = Education (Years of schooling)

$X_3$ = Farm size (hectares)

$X_4$ = Yrs in irrigation farming (years)

$X_5$ = Land holding (Actual ha own)

$X_6$ = Extension services (number of contact)

$X_7$ = Membership of association (Years)

$X_8$ = Household size (Number)

$\beta_0$ = Constant term

$\beta_1 - \beta_8$ = Coefficients to be estimated

$e_i$ = Error term

PS = Propensity Score

1-PS = Expected Probability of PS

**Hypotheses Testing**

### 4.5.5 Chow test statistics

Chow test statistics is among the hypotheses test tool which is often employ to evaluate whether the program has impacts on different sub group population (Dougherty, 2007). The chow is an application of F distribution test; it requires the sum of squares errors from three regressions, one from each sample group and one for the pooled data. If F-Chow is greater than F-table, then the project has impact on the beneficiaries, otherwise no impact. Chow test was employed to test part of hypotheses (ii) which stated that PIM has significant impact on the livelihood of water users. The formula is specified below:

$$F = \text{Chow} = \left(\frac{((RSS - RSS_1 + RSS_2)/k))}{(RSS\_1 + RSS\_2)/(N\_1 + N\_2 - 2K)}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(vi)}$$

Where

$$RSS = \text{Sum of Square Residual of the pooled data}$$

$$RSS_1 = \text{Sum of Square Residual of the first group ie beneficiaries}$$

$RSS_2 =$ Sum of Square Residual of the Second group ie Non Beneficiaries

$N_1N_2 =$ Are number of observation in each group

$K =$ Total number of Parametres in the model

if the test statistic (F*) is greater than the respective F-statistic at 5% level of significance, the null hypothesis should be rejected.

## 4.6 Variable Definition and Measurements

### 4.6 .1 Independent variables

***4.6.1.1 Age ($X_1$):***The actual number of year's respondents has spent from birth to the time of data collection and reported during the survey. Age is believed to be capable of influencing an individual interest, perception, views and conduct: age is expected to affect water users' participation in PIM. It is believed that younger people are more adventurous, less risk-shy and therefore more favourably disposed towards trying new things (Omotayo, 1996). A study conducted by Atala (1981) on factors affecting adoption of agricultural innovation usage of source of information and level of living in two Nigerian villages, which supported that younger people are more adventurous, less risk-shy and more positively disposed towards trying new innovation. The age of the respondent was measured in years.

***4.6.1.2 Level of formal education ($X_2$):***This refers to the type of education acquired through regular or formal attendance of schools and colleges. Level of education was measured by asking the respondents to state the highest level of education they have, whether primary school, secondary school colleges of education/polytechnic and university and the number of years he/she spend in any of the stated schools. The number of years

he/she spent determined the level of his/her education. Therefore, the respondents' level of education was measured in years.

***4.6.1.3 House Hold Size ($X_3$):*** This is thetotal number of persons in the house sharing the same catering arrangement. The size of household is potential to labour availability to the house hold. It is expected to be positively related to participation in PIM in KRIP. It was measured by the number of dependents given by a house hold head during the study period.

***4.6.1.4 Farming as major occupation ($X_4$):*** This is the occupation which water users have reported as his/her primary or major employment, work or profession. In this study it is assumed that the major occupation of the respondents is irrigation farming because it is an important means of water users' livelihood sustainability in the area. It was measured as dummy variable, where 1= yes for farming as major occupation and 0 for otherwise.

***4.6.1.5 Years of experience in irrigated farming ($X_5$):***This variable explains how long the water users' engaged in irrigated agriculture. Respondents' years of experience in irrigated agriculture was measured in years.

***4.6.1.6 WUAs membership ($X_6$):***Water user's membership refers to irrigators' decision to join water management association of his/her command. It was measured as dummy variable, where 1= yes for members and 0= no for nonmembers.

***4.6.1.7 Extension Agent Contacts ($X_7$):*** The role of Extension/Project/Intervention agent is very crucial in disseminating the useful information to the farmers. Extension agent has a

lot of roles to perform in creating awareness, facilitating and mobilizing farmers into group and enlightening the farmers on how to source input and effective market services. Atala (1984) confirmed the importance of extension agent contact in discussion of innovation. The variable can be measured by the total number of times a farmer was visited in connection with PIM concept as reported by the farmers.

***4.6.1.8 WUs perception on irrigation management responsibilities ($X_8$):*** The judgment of water users on irrigation agency and farmers' role in the management of irrigation system. Perception was measured by ranking the water users perceived effect of agency and farmers' involvement in irrigation management at different levels.

The Likert scale was applied to measure the water users' perception on role of irrigation agency on O&M of irrigation scheme, which was scored as follows: very effective 5, effective 4, no opinion 3, less effective 2 and not effective 1. The scores were added and mean was calculated. A mean score of the response was express in percentage to indicate the perceived level of effectiveness of WUAs officials and irrigation agency staff roles.

$$\text{Perception Index} = \frac{\sum (n)}{N}$$

Where:

n= perception score;

N= total number of perception statement

A 32 item instrument, employing a 5 point likert type scale (very effective 5, effective 4, no opinion 3, less effective 2 and not effective 1) was used to describe the water users' perceptions on their officials and irrigation agency roles on PIM.

***4.6.1.9 Land ownership patterns ($X_9$):*** It refers to the land tenure system or the system of land possession by the farmer. Haruna (2004), noted that the pattern of land ownership determine, the farmers' participation in operation and maintenance of irrigation system. He added that rental irrigators normally had lower tendency toward system management participation, compared to those who possessed their farm land through purchased, inheritance or gift. The land ownership pattern was measured and scored as follows: purchased = 4, inherited =3, gift = 2 and lease or rent = 1.

***4.6.1.10 Total Size of farm land ($X_{10}$):*** It refers to the area of land available to the farmer for cultivation. Farm size influences farmers' decision to participate in system maintenance. Study by Haruna, (2004) futher shows that those who are cultivating large area of land participate either physically or financially towards system maintenance. The size of farm land determines the level of farmers' financial commitment in his/her production, hence those who invested more tend to participate and encourage others to participate in system maintenance. Farm size was measured in hectare. Farm size is expected to be positively related to acceptance of PIM policies in KRIP.

***4.6.1.11 Farm locations ($X_{11}$):*** This refers to the location of farmers' plot in the sectors and blocks. It was scored as follows: Head =1, Middle =2 and Tail=3

### 4.6.2 Measurement of Dependent variable

***4.6.2.1 Participation in system operation and maintenance:*** Participation is the involvement of beneficiaries in any development programme/projects right from the decision making, planning implementing and execution of the projects (Hussain2010).

According to World Bank (1996) participation is the total commitment and will of both the initiators and the beneficiaries to carry out annually planned projects to its completion throughout the involvement of the participating agencies and recipients using multi sectorial approach in which people take part in the decision making. The significance measured the rate at which WUs participates in irrigation system O&M at various level. The study was however interested in determining the WUs' socio-economic and institutional factors of the farmer which influence their participation in PIM. Consequently, the socio-economic characteristics (age, farm size, land ownership, educational level, and EAs/Irrigation projects agent contact) were run into multiple regression model to determine their effects on participation.

To measure the extent of participation a composite index was employed to generate participation index, where a value of 1-5 where assigned for the respondent to indicate how frequent he/she participated in irrigation management activities. The composed value was then used as participation index (Y).

Because of the complexity of measurement and lack of simple measurement technique, composite indices were used to measure the following variables for empirical analysis: Extend of participation, Food security index, Extent of crop and income sources diversification, Access to adequate irrigation water, Asset possession and Crop yield index. The details of each of the indices were specified in the appropriate section where such indices were used. Composite score of PIM participation was generated using composite index. The model is specified as follows:

Composite Index for i[th] Water user extent of participation =

$$\rho = \left\{\left\langle\left(\frac{(\overline{X})}{\pi}\right) * x_{ij}\right\rangle + \left\langle\left(\frac{(\overline{Y})}{\pi}\right) * y_{ij}\right\rangle + \left\langle\left(\frac{(\overline{F})}{\pi}\right) * f_{ij}\right\rangle + \cdots \ldots \ldots \ldots \ldots \ldots \left\langle\left(\frac{(\overline{Z})}{\pi}\right) * Z_{ij}\right\rangle\right\}$$

Where;

$\overline{X} = \sum \frac{x_{ij}}{n}$ = Mean of x variable observation = Member ship of association of WU i[th] to WU j[th]

$\overline{Y} = \sum \frac{y_{ij}}{n}$ = Mean of y variable observation = Decision making of WU i[th] to WU j[th]

$\overline{F} = \sum \frac{f_{ij}}{n}$ =Mean of variable observation = Payment of water due by WU i[th] to WU j[th]

$\overline{Z} = \sum \frac{z_{ij}}{n}$ = Mean of Z variable observations= O&M irrigation infrastructures for WU i[th] to WUj[th]

$\pi = \overline{X} * \overline{Y} * \overline{F} \ldots \ldots \ldots \ldots . \overline{Z}$ = Product of means for all variables

### 4.6.3 Impact variables

***4.6.3.1 Livelihoods:***Livelihood in its simplest sense is a means of gaining a living. It also refers to as a combination of the resources used and the activities undertaken in order to live. The resources might consist of individual skills and abilities (human capital), land, savings and equipment (natural, financial and physical capital) and formal support groups or informal networks that assist in the activities being undertaken (social capital). Livelihood Outcomes are the achievements – the results – of livelihood strategies. Outcome categories were examined in relation to the following:

**i. increase crop yield:** This refers to the yield realized from the commodities harvested per unit area of farm plot. It was measured by generating crops yield index as water users differs in number of crops they are growing. It was also measured in kilograms (kg) and

converted to metric ton (mt) of farm produce per unit of farm plot after harvest. It was estimated that the potential yield index of four (4) major crops; rice, wheat, tomato and maize grown in KRIP and WIP is 8.2MT/ha thus assigned 1.0 index. The average WUs' crop yield index estimated as 0.50 (4.1MT/ha) was considered a bench mark, hence any WUs with crop yield above the bench mark is regarded as having an increased crop yield.

**ii.income generating activities:** This refers to the wage earning opportunities provided as a result of any project or interventions. It provides job opportunities in which people engaged and earn a living. Many studies have shown that, the more people have access to available job opportunities the less they can be susceptible to absolute poverty. It is expected that where PIM has been implemented, water users' (farmers) have more access to a number of job available for pay compared to non PIM implemented communities. These variables were measured by the total number of income generating activities listed and the extent to which the respondents engaged. Any WUs within or above the bench mark of 0.50 is regarded as having his/her income generating activities increased

**iii. access to adequate irrigation water:** This refers to access water users' to adequate and timely irrigation water at whatever time he/she fill like to irrigate the crop or farmland based on irrigation scheduled by water users in the community. Composite index was generated and measured the water adequacy according to water users' accessibility to irrigation water. Any WUs within or above the bench mark of 0.50 was regarded as having access to adequate and timely irrigation water.

**iv. asset possession:** This refers to valued farm and house properties such as house; cars; motor cycle; bicycle; farm land; siphon tubes; TV and radio acquired by the respondents. It was measured by the number of assets the respondents possessed. Any WUs with minimum

of seven (7) farm and house assets were considered having a minimum assets possession which is a 0.5 composite index and 50% equivalent.

**v. improved food security:**This is a situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. For the purposes of this research, this definition was widened to include Williams (2002) stance that food security should entail that households acquired acceptable foods in socially acceptable ways without resorting to emergency food supplies, scavenging, stealing, and/or other coping strategies.This was measured base on the respondents' access to sufficient and nutritious food throughout the year. In order to generate this food security index, the nutrient content of the food consumed was used to derived both calorie and protein availability For the water user to be food secured Zi must be greater than or equal to 1 ($Zi > 1$). If Zi is less than 1 ($Zi<1$) the water user is food insecure.

# CHAPTER FIVE
# RESULTS AND DISCUSSION

This Chapter gives information on the impact of PIM on the livelihood outcomes of water users in Kano River Irrigation Project (KRIP). To begin with, it described the socio-economic characteristics of water users in the study area. An effort was made to compare the information obtained from WUs of PIM and non- PIM intervention beneficiaries. Subsequently, the result of the impact assessment was reported and discussed which was followed by discussing the constraints to effective participation and operationalisation of PIM.

## 5.1 Socioeconomic and Institutional Variable of Respondents

### 5.1.1 Socioeconomic characteristics of respondents

#### *5.1.1.1 Age distribution*

Table 5.1 summarizes the socio-economic characteristics of respondents. The result shows that the average age of water users in KRIP was 43 years but with the youngest WUs being about 20 years, and the oldest was above 60 years old, accounting for 32.3% and 9% respectively; whereas the average age of WU in WIP was 44years where the youngest farmer were within the age of 20 years old which accounted for only 3.7%. The result shows that in both sites, farmers were in their forties which is an active stage of farming production. The finding supports the work of Haruna (2004), which indicated that active participation age of farmers in irrigation management is at their forties. On the other hand, the result contradicts the finding of Mohammed *et al.* (2009), in a study conducted at Upper Benue River Basin Development Authority (UBRBDA), who indicated that the average age of irrigation farmers in the area was 60 years old. The reason for this contradiction is that

younger farmers are interested in irrigation management in KRIP and WIP being an important source of income in the areas.

#### *5.1.1.2 Sex*

The sex distribution presented in Table 5.1 shows that 87% and 13% of water users in KRIP were male and females respectively, whereas in WIP 99% were males while only1% were females. Despite the similarity of male domination over female in irrigation farming in the two locations, there were more female participant in KRIP than in WIP. The finding supports the assertion of UNDP (2001) which stated that women usually do not choose to participate in irrigation farming. However, in most cases, it is the absence of able men in the farming that necessitate the involvement of women. The implication of the finding is that if women have much to do on farming operations a part from household responsibilities, more burdens would be on their neck and this will affect children care.

#### *5.1.1.3 Household size*

The household size distribution in Table 5.1 showed that 74.4% and 55% of the respondents had household size of 1-10 in KRIP and WIP respectively. This implies that the two areas had moderate household size which to some extent supports the family labour to cover large farm sizes. The high household number in the study area might be related to respondents' early and polygamous marriage as a result of increased in their farm output and income. The large number of household identified in this study support the finding of Omilola (2009) which indicates about 11 persons per single house hold in a survey carried out in Jiyan, Likori and Turabu villages in Jigawa state. It is therefore concluded that large household size play a significant role in provision of cheap family farm labour, while on the other hand increases expenditure patterns of the household.

### *5.1.1.4Level of Formal education*

Variation in the level of educational attainment by the respondents in the study area was very clear. The result presented in Table 5.1 revealed that 37%, 26% and 44% of the water users in KRIP acquired primary, secondary and tertiary level of education respectively. Whereas in WIP 50%, 46% and 2% of the respondents have acquired primary, secondary and tertiary level of education accordingly. The improvement in the level of formal educational attainment in the study areas may not be unconnected with the universal basic primary education introduced in 1976 in the states. However, this contradicts Omilola (2009) who found that about 50% of rural farmers in Northern Nigeria obtained *Qur'anic* education only as their highest level of education.

### *5.1.1.5 Years of experience in irrigation farming*

The result in Table 5.1 also shows that the mean of water users' years of experience in irrigated agriculture, with KRIP was 19 years while that of WIP was 17 years. Water users who put more years in irrigation farming were likely to participate in irrigation scheme management. Similarly, more years of experience in WUAs could have positive influence in their participation in the management of irrigation infrastructure. The result corroborate the findings of Haruna, (2004) who observed that water users with mean age of 14 years' experience in irrigation farming participated more than their fellow water users with less years of experience in irrigation farming.

### *5.1.1.6 Farming as major occupation of water users*

The result in Table 5.1 further shows that 81% and 87% of the respondents in KRIP and WIP respectively indicates that farming is their major occupation. The finding depicted the

achievement of the goal of introducing irrigation project which is to provide the beneficiaries with job opportunity in agriculture for sustainable livelihood.

Table 5.1: Socioeconomic characteristics of water users

| Socioeconomic Variables | KRIP | | | WIP | | |
|---|---|---|---|---|---|---|
| | **Frequency** | **Percent** | **Mean** | **Frequency** | **Percent** | **Mean** |
| **Age** | | | | | | |
| 20-29 | 105 | 32.3 | | 10 | 3.7 | |
| 30-39 | 151 | 46.5 | 42.9 | 71 | 26.5 | 43.5 |
| 40-49 | 65 | 20.0 | | 100 | 37.3 | |
| 50-59 | 1 | .3 | | 66 | 24.6 | |
| 60 & above | 3 | .9 | | 20 | 7.8 | |
| **Sex** | | | | | | |
| Male | 284 | 87.4 | | 266 | 99.3 | |
| Female | 41 | 12.6 | | 2 | 0.7 | |
| **House hold size** | | | | | | |
| 1-10 | 242 | 74.4 | | 147 | 54.9 | |
| 11-20 | 76 | 23.4 | 8 | 97 | 36.2 | 9 |
| 21-30 | 7 | 2.2 | | 24 | 8.9 | |
| **Educational level** | | | | | | |
| Non-formal education | 35 | 10.8 | | 5 | 1.8 | |
| Primary education | 121 | 37.2 | | 133 | 49.6 | |
| Secondary education | 142 | 25.5 | | 123 | 45.9 | |
| Tertiary education | 27 | 43.7 | | 7 | 2.6 | |
| **Experience in Irrigation farming** | | | | | | |
| 10 Years | 89 | 27.4 | | 57 | 21.3 | |
| 11-20 | 112 | 34.5 | 19.3 | 130 | 48.5 | 16.8 |
| 21-30 | 108 | 33.2 | | 55 | 20.5 | |
| 31and above | 16 | 4.9 | | 26 | 9.7 | |
| **Farming as major occupation** | | | | | | |
| Major | 61 | 18.8 | | 36 | 13.4 | |
| Not major | 264 | 81.2 | | 232 | 86.6 | |

### 5.1.2 Institutional variables

#### *5.1.2.1 Extension Agents Contacts*

The result in Figure 3 shows extension agents contact and the extent to which water users are satisfied with EAs' visits regarding the management, operation and maintenance of irrigation infrastructures. From the Figure, 49 % and 56% of water users in KRIP and WIP respectively had access to extension contact. The higher proportion of EAs' contacts received by WIP water users was as a result of more EAs allocation by the State ADP than HJRBDAs.

The finding also indicates that, there was inadequate contact with water users by extension agents in KRIP. This could be attributed to deregulation and privatization policy which enforced handing over of some irrigation management responsibilities to farmer organizations and private service providers on River Basin Development Agencies managed by the Federal Government. Correspondingly, with respect to water users' satisfaction of EAs' visit to discuss issues and training on system O&M, only about 44% and 32% of respondent in KRIP and WIP respectively were satisfied with joint irrigation management orientation and facilitation given to them by the EAs. This finding support Khalid*et al.* (2006) who opined that sustainable change in management and conservation of natural resource, is based on the technological orientation and roles of institutional agents in ensuring the attainment and continued satisfaction of human needs for present and future generations. The implication of this finding is that EAs are not adequately trained to facilitate and train water users on O&M of irrigation system as such they need to be adequately trained.

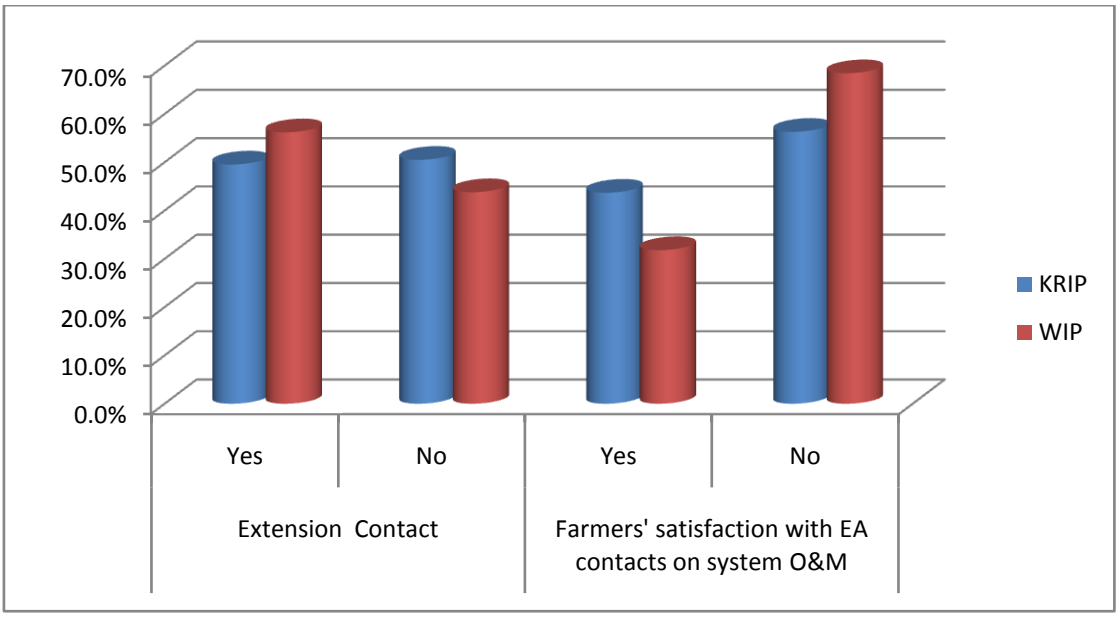


Figure3: Extension agents contact with water users and their satisfaction with visits

### *5.1.2.2 Water users' membership in associations*

From the result presented in Table 5.2 it shows that 56% and 84.3% of the respondents in KRIP and WIP respectively registered in one or more associations. More respondents in WIP registered in many cooperative societies than their counterpart in KRIP. This was as a result of massive Kano Agricultural and Rural Development Authority (KNARDA) campaign in 2003-2005 on special mass food production programmes, which emphasized farmers' group formation for easy access to farm inputs subsidy within the state, with particular reference to WIP being the largest state owned and managed irrigation scheme. Cumulatively, 69% of the respondent in study areas registered in various cooperative groups. This is an indication that generally water users in the area patronized different associations, which enhances their sustainability and overall development in agriculture.

The result in Table 5.2 further shows that 41% of the total respondents registered as WUAs' members of KRIP and WIP. Based on the finding, 61.5% and 16.1% of the respondents in KRIP and WIP registered as members of WUAs. The higher percentage of registered WUAs membership in KRIP is closely associated with CIRAD/ADENI projects which mobilsed and strengthens FOs and WUAs for effective participation in irrigation management. On the other hand, low WUAs membership of 16.1% in WIP proof the finding of Federal Ministry of Water Resources & Food and Agriculture Organization (2004) which shows that low membership participation in WUAs in the area.

The implication of the finding is that low water users' membership in WUAs could lead to unsustainable irrigation scheme management which lower productivity. It is therefore suggested that WUAs should be strengthened in KRIP while sensitization and mobilization campaign should be adequately mounted in WIP to encourage water users to form association of irrigation management for sustainability and increase productivity.

Table 5.2 Water users' membership in associations

| **Locations** | **Extent of member ship** | **Cooperative Membership** | | | **WUA Membership** | | |
|---|---|---|---|---|---|---|---|
| | | **Yes** | **No** | **Total** | **Yes** | **No** | **Total** |
| **KRIP** | Frequency | 182 | 143 | 325 | 200 | 125 | 325 |
| | % | (56.0) | (44.0) | (100.0) | (61.5) | (38.4) | (100.0) |
| **WIP** | Frequency | 226 | 42 | 268 | 43 | 225 | 268 |
| | % | (84.3) | (15.7) | (100.0) | (16.1) | (84.0) | (100.0) |
| **Total** | Frequency | 408 | 185 | 593 | 243 | 350 | 593 |
| | % | (68.8) | (31.2) | (100.0) | (40.9) | (59.1) | (100.0) |

**Note:** Figures in parentheses are percentages

## 5.2 Extent of Water Users' Participation in Irrigation Management

### 5.2.1 Participation in farming system

Result in Table 5.3 presents the magnitude of water users' participation in different system of farming practiced in the study areas. The result shows that irrigation farming had 77.8% and 13.4%, rain fed had 2.2% and 2.6%, while both irrigation and rain fed had 20.0% and 84.0% in KRIP and WIP respectively. The finding shows that more water users in KRIP were into sole irrigation farming than WIP water users. This is in line with findings by Hussain and Hanjra (2004), Smith (2004) and Lipton (2007) that access to irrigation water at the right time needed by the crops give farmer confidence in irrigation farming. However, combined irrigation and rain fed farming is the major type of farming practiced by water users in WIP; though to some extent water users in KRIP also engaged in rain fed farming. The implication of the finding is that there are areas which are not completed within the project plots that do not have access to irrigation water. For this reason farmer who put such plots under cultivation preferred to adopt early maturing crops in the period of wet season, irrespective of yield per hectare.

Table 5.3: Types farming practice by water users

| Locations | Responses | Types of farming | | | |
|---|---|---|---|---|---|
| | | Irrigation | Rain fed/upland | Irrigation & Rain fed | Pooled |
| KRIP | Frequency | 253 | 7 | 65 | 325 |
| | % | 77.8 | 2.2 | 20.0 | 100.0 |
| WIP | Frequency | 36 | 7 | 225 | 268 |
| | % | 13.4 | 2.6 | 84.0 | 100.0 |
| Total | Frequency | 289 | 14 | 290 | 593 |
| | % | 48.7 | 4.8 | 48.9 | 100.0 |

### 5.2.2 Level of participation in irrigation management

The result in Table 5.4 shows that 96% and 92% of the respondents participate at farm operation in KRIP and WIP respectively. There was high level of participation (84%) by KRIP water users on field canal clearance whereas 46% of WIP respondents participate in the same exercise. Similarly, 52% and 23% of the respondents participate in distributary canal de-silting and de-weeding in KRIP and WIP locations respectively.

The result further shows that the level of involvement of the respondents in the following activities; WUAs membership 61.5% and 16.1%, conflict management among water users' 56% and 44% payment and collection of water charges 74% and 54 %, decision making process 27% and 17% then record keeping 12% and 15% in KRIP and WIP respectively. Higher level of participation by KRIP water users in FC, DC, WUAs membership, conflict management, decision making process and payment and collection of water charges is an evidence which portrays the influence of PIM implementation in the area.

These results corroborate with the findings of FAO and FMWR (2004) that identified high level of water users' participation in PIM implemented irrigation schemes at tertiary level and water charge collections, but low level of participation in other aspect of irrigation management. This finding also support that of Rao *et al.* (2012) and Jinapala *el al.* (2014) who observed high level of water users participation in jungle cleaning and de-silting of DC and less involvement in decision making process. The implication of this finding is that, agency and WUAs' official are more concerned on water users' participation at lower level (FCs and DCs) and perceived respondents as not technically and literate enough to be

involved in decision making process. As the matter of pact, agency and WUAs' official should ignore these perceptions and carry WUs at level of irrigation management.

Table 5.4: Extent of participation in irrigation management

| | KRI | | WIP | |
|---|---|---|---|---|
| **PIM Activities** | **Frequency** | **%** | **Frequency** | **%** |
| Decision making process | 88 | 27 | 56 | 17 |
| Farm level operation | 312 | 96 | 299 | 92 |
| Field canal clearance | 273 | 84 | 150 | 46 |
| Distributary canal clearance | 169 | 52 | 75 | 23 |
| Main canal clearance/maintenance | 39 | 12 | 20 | 6 |
| WUAs formation | 202 | 62 | 55 | 17 |
| Conflict resolution | 182 | 56 | 143 | 44 |
| Payment and collection of water charges | 241 | 74 | 176 | 54 |

### 5.3Extent of WUs' Income Sources and Crop Diversification

The key components of PIM were assessed based on certain criteria and indicators. These indicators (decision making process, Farm level operation, Field Canal clearance, Distributary Canal clearance, Main Canal clearance/maintenance, WUAs formation and payment and collection of water charges) were used to assess the progress, outcomes and impact of irrigation schemes that are managed through PIM. Since there are no common or universally accepted criteria and indicators to measure the performance of PIM, the achievement in long term objectives would provide status of PIM impact. Basically there are two long term objectives; hand over of some M&O to farmers' organizations (WUAs) and income and crop diversification.

### 5.3.1 Water users' income source diversification

The result in Table 5.5 shows that water users in KRIP and WIP had other occupations as diversified sources of income apart from irrigation farming. The finding revealed that water users engaged in transportation by 14.4% and 5.2%, animal rearing/fattening 15.7.1% and 54.1%, artisan 12.9% and 3.0%, civil service12.6% and 7.5%, trading 30.2% and 28.0%, tailoring 3.4% and 1.5% and weaving was 21.2% and 0.7% in KRIP and WIP respectively. When comparing the two locations, water users in KRIP participate more than WIP in artisan, civil service, tailoring, and weaving, by 9.9%, 5.1%, 2.1%, and 20.5%, respectively.

However, results show that participation of water users in animal rearing/fattening was15.7% and 54.1% in KRIP and WIP respectively, meaning that, water users were better off in WIP than KRIP in animal rearing/fattening. The higher level of engagement in occupational opportunities by KRIP respondent provides substantial contribution by non-irrigation farming and hence would provide resources to water users to have adequate mean of purchasing inputs and hiring labour. The implication of this finding is that there are tendencies for water users' diversion to non-irrigation farming. The study support the finding of World Vision (2004) and Monde (2003) who confirmed that in South Africa, agricultural activities hardly constitutes the only income sources to among rural household. Pradhan (2002) in his study, also identified and support the diversifying activities by water users to meet the needs of their members for other services so as to have more income and secure enjoyable living in the community.

Table 5.5: Water users' source of income apart from irrigation farming

| Locations | Responses | Other Occupations/source of income | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Transportation | Animal fattening | Artisan | Civil service | Tailoring | Trading | Weaving |
| KRIP | Frequency | 13 | 51 | 42 | 41 | 11 | 98 | 69 |
| | % | (4.0) | (15.7) | (12.9) | (12.6) | (3.4) | (30.2) | (21.2) |
| WIP | Frequency | 14 | 145 | 8 | 20 | 4 | 75 | 2 |
| | % | (5.2) | (54.1) | (3.0) | (7.5) | (1.5) | (28.0) | (0.7) |
| Pooled | Frequency | 88 | 196 | 50 | 61 | 15 | 168 | 15 |
| | % | (14.8) | (33.1) | (8.4) | (10.3) | (2.5) | (28.3) | (2.5) |

**Note:** Figures in parentheses are percentages

### 5.3.2 Extent of crops diversification by water users in KRIP and WIP

The result in Table 5.6 shows the extent to which water users in KRIP and WIP diversified in their crop production. It indicates that water users in KRIP diversified their cropping, there by planting about eight (8) different crops namely; rice 98%, wheat 37%, maize 58%, tomato 39%, onion 44%, water melon 5%, cucumber 8% and cabbage 3%. Similarly, the water users in WIP concentrated on rice 68%, wheat 3%, maize 22% and onion 20%. Crop diversification is an indicator for the accomplishment of long term objective of PIM implementation in irrigation scheme.

Wide spread of cropping patterns among water users in KRIP signified their extensive experience in production of different crops which could be as a result of interaction with water users from different location of the country and right to decision making regarding the type of crops they considered as market attractive, scarcely produced by farmers and highly demanded by consumers. The finding is in line with Jinapala (2015) who identified crop diversification among water users in PIM implemented irrigation scheme and consider the effort as positive to its accomplishment. Similarly the finding also corroborated with study conducted by Madhusuda *et al*. (2002) who reported that in India better access to

irrigation has facilitated intensification of cropping practices, inputs used and contributed to the "modernisation" of the agricultural sector.

Table 5.6: Extent of crops diversification

| | KRIP | | WIP | |
|---|---|---|---|---|
| **Crops** | **Frequency** | **%** | **Frequency** | **%** |
| Rice | 318 | 97.8 | 182 | 67.9 |
| Wheat | 120 | 36.9 | 8 | 2.9 |
| Maize | 188 | 57.8 | 59 | 22.0 |
| Tomato | 127 | 38.7 | 220 | 82.1 |
| Onion | 111 | 34.2 | 54 | 20.1 |
| Water melon | 16 | 4.9 | 0.0 | 0.0 |
| Cucumber | 26 | 8.0 | 8 | 3.0 |
| Cabbage | 10 | 3.1 | 0.0 | 0.0 |

### 5.4 Socio economic Factors Influencing WUs' Participation in Participatory Irrigation Management Intervention

The result in Table 5.7 shows the socio economic factors influencing WUs participation in large scale irrigation scheme management at different levels of participation right from farm level. The result shows that; farming as the major occupation of water users (1.037), experience in irrigation farming (0.083), membership in WUA (0.96), frequency of extension contact (0.163) have a positive influence on water user participation in irrigation management at 1% level of significance. The finding is in line with that of Makadho (1993) and Murtala (2001) who ascertained that, for effective water users' participation in irrigation management activities, certain socioeconomic and institutional variables like farmer career in agriculture, membership in farmer organisations and activities of extension workers contributed in the participation of water users in irrigation management. Moreover the result agreed with Haruna (2004) who indicated that years of water users experience

significantly influenced their participation in irrigation management. He further concluded that technical skills and experience were the determinant factors of farmers' involvement in irrigation farming. This implies that experienced farmers in irrigation agriculture are more competent and committed to management activities than non-experienced ones. Therefore socio economic and institutional factors such as WUAs membership and EAs' contact should be enhance to influence WUs participation injoint irrigation management for sustainability.

The Table 5.7 further shows that age of water user (-.104), years in school (-.111) and total farm size (-.320) negatively influenced participation at 1% level of significance. This may not be unconnected with the fact that aged, highly educated and those who owned large hectares of land and mostly rented their land to others have participated little in management of irrigation scheme. The negative effect might be that majority (above 70%) of the respondent fall between 20 – 40 years of age, who seems to be fairly enlightened and perceived project agency to take the responsibilities of system operation and maintenance as Haruna (2004) ascertained. House hold size, Water user Perception on Agency/WUA official roles and location of farm under irrigation scheme are not significant at all levels. This implies that larger household size is not important factor on water users' participation in irrigation management due to the fact that communal/family labour is diminishing in the area while semi commercial farming, which is more dependent on hired labour is more commonly practice. The collective contribution of socio economic variables of $R^2$ value of 0.67 in the model summary explained the percentage variation in WUs' participation in PIM. Non influence of Water users' perception of Agency/WUAs' official roles on respondents' participation did not correspond with Haruna (2004) findings, which opined

that irrigation farmers perceived large scale irrigation as drought relief and social services that can best be maintained by irrigation agencies for sustainability.

**Test of Hypothesis $Ho_1$**

It was hypothesized that water user's socio-economic and institutional variables of the beneficiary water users have no significant influence on their participation in the PIM intervention. The result in table 5.7 shows that; farming as major occupation of water users, experience in irrigation farming, membership in WUA, frequency of extension contact had a positive influence on water user participation in PIM intervention at 1%. Similarly $R^2$ value of 0.67 showed variation in KRIP WUs' participation was explained by their socio economic characteristics. Therefore, the null hypothesis is rejected and the alternative hypothesis is than accepted, meaning that socio economic and institutional variables influence WUs' participation in irrigation management.

Table 5.7: Multiple regression results of socio economic factors affecting WUs' participation in PIM interventions

| Socioeconomic and institutional variables | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | 4.729 | .521 | | 9.084 | .000 *** |
| Age | -.104 | .009 | -.651 | -11.988 | .000*** |
| Years in school | -.111 | .028 | -.208 | -3.957 | .000*** |
| House hold size | -.220 | .104 | -.110 | -2.127 | .034** |
| Farming as major occupation | 1.037 | .092 | .603 | 11.331 | .000*** |
| Years of experience in irrigation farming | .083 | .012 | .424 | 7.087 | .000*** |
| Member ship in WUA | .963 | .195 | .307 | 4.940 | .000*** |
| Frequency extension contacts | .163 | .017 | .400 | 9.738 | .000*** |
| Water user perception on agency/WUA official roles | -.001 | .001 | -.040 | -1.091 | .276ns |
| Patterns of land ownership | -.021 | .191 | -.005 | -.110 | .912ns |
| Total farm size under irrigation | -.320 | .043 | -.311 | -7.491 | .000*** |
| Location of farm under irrigation | -.071 | .072 | -.039 | -.997 | .320ns |

*** significant at 1%, and ** significant at 5%

a. Dependent Variable: Extent of Participation (Participation index in values)

b. Number of observations = 324 c. R Square = .667 d. Adjusted R Square = .656

## 5.5 Water users' Perception of WUAs' Official and Irrigation Agency Personnel' Roles on the Management of Irrigation System

The association's officials indicators were grouped into five institutional categories; associational, operation and maintenance, water and financial management and organizational linkages, while, irrigation agency's role were indicated by roles related to irrigation management activities.

### 5.5 .1Water users' perceived effectiveness of WUAs officials' role performance

The resultin Table 5.8 showed water users' perception on WUAs' Officials roles. These roles have the potentials of influencing the assessment of PIM indicators toward successful

WUs' participation in irrigation management. Associational role such as; leadership capabilities (72.4%), water users' awareness on WUAs status (69.4%), productive meeting (63.8%), voluntary labour contributions (73.4%) and voluntary financial contribution (53.6%) were roles perceived to be effectively played by WUAs' officials in KRIP. Whereas social audit and transparency (38.8%) were perceived roles not effectively play.

In WIP, the entire institutional roles mentioned above felled between 49% and 56% implying that the roles were not highly played by WUAs' officials. The result further indicates that the positive perception by respondents in KRIP toward WUAs' official influenced their efforts to participate in the management of irrigation scheme in the study area. Water users' associations played significant role in operation and maintenance of irrigation system. The indices of O&M which includes removal of silt and weeds (62.8%), repairs and protection of irrigation infrastructures (65.4% & 68.8%) and dispute management (74.2%), implies that were effectively performed by KRIP WUAs. However, the perception of these activities was less effective in the case of WIP.

The result support Wijayaratna (2004) finding which expressed the role of private sector/organisations like WUAs, in developing countries of Asia on O&M service provision, input supply, ensuring active participation of water users in decision making across different levels. These organisations also ensure effective linkages system among the associations.

The result in Table 5.8 further revealed that water management roles played by WUAs' officials were less, effective as Perceived by respondents from KRIP and WIP. However,

concerning information and efforts to ensure equity in water distribution which was 71.2% and 52.2% level of effectiveness is seen as one of the positive effort WUAs officials were making in KRlP and WIP. It is also shown in table 5.8 that water users (70.2% ) in KRIP perceived WUAs officials as highly effective in making effort to generate fund, the situations was not perceived the same (48.8%) in WIP as reported by water users. On the same vein, WUs in KRIP and WIP indicates low effort of water users associations' officials in efficient and good in utilizing the money generated for maintenance and operation processes and financial auditing. However, 70.2% WUs in KRIP and 50.2% in WIP believed that WUAs officials were effective in fund generation and financial auditing.

The finding in Table 5.8 further present a role played by WUA, officials regarding organisational linkages which comprises of adequate linkages with Other WUAs, information and communication and discussing with competent authority . Effort to ensure adequate linkages with other WUAs (72.4%) and information and communication (65.8%) highly perceived effective by KRIP respondents. This is contrary in the case of WIP in which organisational linkages was perceived as not effective. Similarly effort to make regular discussion between WUAs officials and competent authorities were 56.8% and 58.2% level of effectiveness in KRIP and WIP. The implication of the finding is that good perception enhance the beneficiary participation in any project intervention, therefore all efforts to ensure better understanding and confidence of the beneficiaries should be the top priority of WUAs and irrigation agencies. Such priorities should include: social audit/transparency, adequate and timely water supply as well as discussion with competent authorities regularly pertaining to system maintenance.

Table 5.8: Water users'perceived effectiveness of Water Users Associations Officials' role performance

| WUs' Perception of WUAs officials' roles performance | KRIP | | | WIP | | |
|---|---|---|---|---|---|---|
| | Wtd Sum | Wtd Mean | % Mean | Wtd Sum | Wtd Mean | % Mean |
| **A. Associational roles** | | | | | | |
| i. Leadership capability | 3856 | 3.6 | 72.6 | 705 | 2.7 | 54.2 |
| ii .Members awareness about WUA status | 1140 | 3.5 | 69.4 | 699 | 2.6 | 52.8 |
| iii. Productive meetings | 1050 | 3.2 | 63.8 | 623 | 2.3 | 46.8 |
| iv. Voluntary physical/labour contribution | 1206 | 3.7 | 73.4 | 685 | 2.5 | 49.2 |
| v. Voluntary financial contribution | 953 | 2.7 | 53.6 | 557 | 2.3 | 45.6 |
| vi. Social Audit/ Transparency | 624 | 1.9 | 38.6 | 780 | 2.8 | 56.4 |
| **B. Operation and maintenance** | | | | | | |
| i. Removal of silt and weeds | 1009 | 3.1 | 62.8 | 462 | 1.7 | 34.4 |
| ii. Repairs/maintenance of structure | 1076 | 3.3 | 65.4 | 601 | 2.3 | 46.2 |
| iii. Protection of structure | 1122 | 3.4 | 68.8 | 633 | 2.4 | 48.8 |
| iv. Dispute management | 1224 | 3.7 | 74.2 | 730 | 2.7 | 54.6 |
| **C. Water management** | | | | | | |
| i. Adequate and timely water supply | 825 | 2.5 | 49.6 | 696 | 2.6 | 51.2 |
| ii. Information about water distribution | 1182 | 3.6 | 71.2 | 728 | 2.6 | 52.2 |
| iii. Efforts to save water | 941 | 2.9 | 58.8 | 688 | 2.6 | 52.6 |
| **D. Financial management** | | | | | | |
| i. Fund generation | 1158 | 3.5 | 70.2 | 624 | 2.4 | 48.8 |
| ii. Utilization of maintenance and operation fund | 928 | 2.4 | 48.4 | 581 | 2.4 | 48.4 |
| iii. Financial audit | 825 | 2.5 | 49 | 676 | 2.5 | 50.2 |
| **E. Organizational linkages** | | | | | | |
| i. Adequate linkages with other WUAs | 1170 | 3.6 | 72.4 | 666 | 2.4 | 47.6 |
| ii. Information and communication | 1079 | 3.3 | 65.8 | 655 | 2.5 | 49.6 |
| iii. Discussion with competent authority regularly. | 910 | 2.8 | 56.8 | 744 | 2.9 | 58.2 |

**Wtd =** Weighted

### 5.5.2 Water user's based on perceived effectiveness on irrigation agency role in PIM

The result in Table 5.9 revealed that mobilizing water users to form WUAs 62.2% and 64.8%, imposing punishment against defaulters of water charges 82.0% and 72.0% level, facilitation of WUs on field channel clearance 73.8% and 54.8% and perception level was considered effective by WUs in KRIP and WIP. In Table 5.9, results also show that 69% and 54.8% of the respondents in KRIP and WIP perceived irrigation agency role in helping water users to resolve conflict as effective. Training of water users on how to operate and maintain irrigation facilities 44.8% and 48.8% in KRIP and WIP was not effective. Adequacy and timely water released at 48.6% and 64.2% level were perceived not effective in KRIP and otherwise in WIP.

The results further showed that helping water users to resolve conflicts 73.8%, facilitating field canal clearance 55.6%, and repairs of WCs 62.8% were perceived effectively done by agency according to KRIP water users whereas in WIP it was concluded not effective. Other irrigation agency management roles which wereperceived effective in KRIP and WIP was involving water users for decision making with 56.6% and 51.2%.

The finding revealed that majority of the respondents in KRIP perceived role played by agency as effective. On the other hand, less than fifty percent (50%) of the respondents in WIP have contrary opinion and perceived agency role as not effective. The result is line with findings of Haruna (2004) which identified negative opinion of water users on role played by irrigation agency. However, this is a threat to the finding of Kazaure (2001) who is of the opinion that arrangement and procedure for the effective implementation and takeover responsibilities of O&M by water users should be through adequate arrangement

and commitment of agency to ensure better relationship between farmers and agency and with adequate training to prepare water users for effective takeover.

The implication of the finding is that with the failure of irrigation agency to perform their expected roles, irrigation management sharing will remain unfulfilled. It is therefore, suggested that management of irrigation agency and relevant stakeholders for PIM facilitation should provide adequate re-orientation for irrigation agency personnel on the role expected of them, on the side of System maintenance was agreed to be the responsibilities of the agency, whereas the funding agencies responsible for funding of irrigation agencies, should ensure adequate and timely release of fund.

Table 5.9: Water users' perceived effectiveness of irrigation agency role in PIM

| **WUs Perception of irrigation agency effectiveness** | **KRIP** | | | **WIP** | | |
|---|---|---|---|---|---|---|
| **Irrigation management activities** | **Wtd Sum** | **Wtd Mean** | **% Mean** | **Wtd Sum** | **Wtd Mean** | **% Mean** |
| i. Mobilized farmers to form WUAs | 2958 | 3.1 | 62.2 | 857 | 3.2 | 64.8 |
| ii. Train farmers to operate and maintain irrigation facilities | 734 | 2.2 | 44.8 | 645 | 2.4 | 48.8 |
| iii. Timely and adequate water released | 740 | 2.4 | 48.6 | 809 | 3.2 | 64.2 |
| iv. Dealing with channel breakers | 1164 | 3.6 | 72.2 | 609 | 2.3 | 45.6 |
| v. Punishment to whoever fail or refuse to pay water charges | 1308 | 4.1 | 82 | 973 | 3.6 | 72 |
| vi. Help farmers to resolve conflict | 1205 | 3.7 | 73.8 | 703 | 2.7 | 54.8 |
| Vii. Involving farmers decision in making process | 919 | 2.8 | 56.6 | 678 | 2.6 | 51.2 |
| viii. Facilitating Field Canal clearance | 742 | 2.8 | 55.6 | 619 | 1.3 | 26.4 |
| ix. Facilitating Distributary Canal clearance | 742 | 2.1 | 42.6 | 704 | 2.7 | 53.4 |
| x. Repairs of Main Canal | 1118 | 3.4 | 68.8 | 801 | 3 | 60 |
| xi. Repairs of Water Control infrastructures | 1194 | 2.8 | 55.6 | 826 | 3.1 | 62.8 |
| xii. Field drainages | 640 | 2.4 | 48 | 727 | 2.7 | 54.6 |
| xiii. Service road | 665 | 2.1 | 42.2 | 822 | 3.2 | 64.2 |

**Wtd =** Weighted

### 5.6 Impact of PIM on WUs' Livelihoods

Proceeding to non-parametrically estimating the impact of the scores required specification justifying that water users had been involved in PIM. Consequently we had to respect the conditional independence assumption that the covariates are exogenous and not affected by the PIM programme. Caliendo and Kopeinig (2008) stated that matching between participant and non participant of the programme is basic in order to compare the similarities between the two groups in term of set of perceived characteristics. This requires predicting the propensity scores for each individual using a logistic regression model.

This study employed logistic model to predict the probability that water users participate in the PIM intervention, where different socioeconomic characteristics of water users were included as explanatory variables. As indicated in Table 5:10, major occupation, WUAs membership, extension frequency, total farm size, experience in irrigation and extent of participation significantly influenced water users involvement in PIM at 1%. As expected, age, years in school and cooperatives member negatively influenced water users involvement in PIM. However, household size and water users' perception were not significant over their involvement in PIM. The estimated mean propensity score using main specification for the whole sample was 0.68 implying that the average probability of participating in PIM for all individual water users was 68%.

Table 5.10: Logistic estimates for some degree of propensity of WUs' socio economic and in irrigation management (n=593)

| Variables | Coefficient. | Std. Errow | z | P>z |
|---|---|---|---|---|
| Age | -0.3419 | 0.0560 | -6.1000 | 0.00*** |
| Years in school | -1.6053 | 0.3200 | -5.020 | 0.00*** |
| Household size | -0.0056 | 0.0649 | -0.0806 | 0.93ns |
| Major occupation | 2.5861 | 0.8823 | 2.930 | 0.00*** |
| Years of experience in irrigation | 0.1246 | 0.0378 | 3.300 | 0.00*** |
| WUAs membership | 0.0325 | 0.0048 | 6.710 | 0.00*** |
| Extension frequency | 0.1486 | 0.0560 | 2.650 | 0.01*** |
| WUs' perception | 0.9652 | 0.6428 | 1.500 | 0.130ns |
| Land ownership patterns | -0.8650 | 0.2019 | -4.290 | 0.00*** |
| Total farm size | 0.1920 | 0.0973 | 1.970 | 0.05 ** |
| Location of farm land | -0.3496 | 0.5720 | -0.610 | 0.54 ns |

**Note:** Dependent variable 1 for KRIP water users and 0 other wise for WIP water users
Probability level *** =1% and ** = 5%
$R^2$ = 0.6784
Log likelihood = -49.646999

The result in Table 5.11 specifically shows the impact of PIM on water users' livelihoods. The threshold line of 0.69 in KRIP and 0.61 in WIP indicates that WUs in the two locations were above the threshold line of 0.5 which was a composite index of increased income sources, meaning that both KRIP and WIP were 19% & 11% above the threshold line respectively and significant at 1%. As such, they were considered as having diversified sources of income. Similarly, the ATE in KRIP was 8% above their counterparts in WIP.

The result in Table 5.11 also shows the WUs access to adequate and timely irrigation water. Water users within or above the threshold line of 0.5 are regarded as having access to irrigation water at any time to irrigate his/her crops and or farm land. The result in this study indicates that WUs in KRIP were above the threshold line with about 0.65 index lines whereas WIP WUs fall below the threshold line with about 0.16 index line. This shows that

there was a variation (gap) of 0.48 which is equivalent to 48% of KRIP water users had access to adequate irrigation water than WIP water users. Thus a significant level of 1% indicates that KRIP water users had access to adequate irrigation water with good facilities whereas WIP water users had less access to adequate irrigation water at any time. This finding corroborates the findings of Madhusuda *et al.* (2002) which indicated that availability and access to irrigation infrastructure, coupled with the availability and access to new technologies such as high yielding varieties and fertilizers, were the major underlying factors for the success of the green revolution in India. They noted that better access to irrigation water has facilitated intensification of cropping practices and inputs uses which contributed to the "modernisation" of the agricultural sector. The result also support the findings of Orlando and Luzviminda (2007) who showed that community participation in irrigation project increase production through increased water supply, and protect the environment that supports the project with the community as the main actors of the development process.

Table 5.11: Impact of PIM on water users' livelihoods

| **Livelihoods outcome** | **KRIP (Mean)** | **WIP (Mean)** | **ATE** | Std. Deviation | | Std. Error | | **t-value** |
|---|---|---|---|---|---|---|---|---|
| | | | | **KRIP** | **WIP** | **KRIP** | **WIP** | |
| Increased income sources | 0.694 | 0.607 | 0.09 | 0.155 | 0.227 | 0.009 | 0.014 | 5.518*** |
| Access to adequate irrigation water | 0.647 | 0.168 | 0.48 | .091 | .345 | .005 | .021 | 24.035*** |
| Increased assets possession | 0.419 | 0.359 | 0.06 | .193 | .489 | .012 | .028 | 1.890* |
| Improved food security | 1.601 | 1.364 | 0.24 | 1.028 | .294 | .057 | .018 | 3.640*** |
| Increased crop yield | .75(6.22) | .74(6.0) | .1(0.11) | .007 | .068 | .001 | .004 | 3.383*** |

*** Significant at 1% and *significant at 10%
Figures in parenthesis are in MT/ha

The result in Table 5.11 further revealed that the assets possessed by water users in the study area. The threshold line of 0.5 indicates the average assets of water users' possessions. The result shows that in both locations water users average assets possession was below 0.5 was not meet as such was not positively significant. However, the KRIP respondents had average assets of 0.42 which is 0.06 (6%) above WIP water users who had average assets of 0.36, despite the fact that water users in WIP owned more or larger farm land than their counter part in KRIP. On the other hand KRIP water users owned more valuable farm and home assets such as concrete houses, motor cycles, cars, Trucks, tractors and its implements which could be attributed to the years in experience put by KRIP water users in irrigation management. This finding corroborates FAOs (n.d) finding which revealed that in Zimbabwe small scale irrigators who participated in irrigation farming managed to possessed assets like trucks, small cars and an average of five cattle each. The implication of the finding is that full participation of water users in irrigation management should be supported for them to have access to adequate irrigation water. This will enhance their assets possession and increased income.

The result in Table 5.11 further shows the water users food security index line/threshold. Water users with threshold line of 1 and above were regarded as food secured. The result shows that the respondents' food security level in the study areas was above the threshold line of 1 indicating that they were food secured and significant at 1% level. However, the KRIP respondents attained 1.60 food security index indicating that they were more food secured than their WIP counterpart who attained 1.36 food security index. The attainment of food security level in the locations may not be unconnected with the impact of irrigation projects in the area which is a determinant of farmers crop output and diversification. The

finding support the study carried out by FAO (n.d) which opined that farmers in an irrigation scheme with relatively low rainfall have access to adequate food under well manage or effectively utilized water resources. The study added that farmers from neighboring irrigation communities come to buy food items in irrigation scheme locations. Also, Awulachew *et al.* (2007) found that following the attention given to Tigray region with erratic and untimely rainfall by the regional government food security was ensured. Moreover, Huang (2006) pointed out that farmer participation in irrigation increases their consumption expenditure and consequently improved food security status.

The result in table 5.11 further shows the impact of PIM on water user's crop yield. It shows that the KRIP respondents' average was 0.75 equivalents to 6.21MT crop yield per hectare; whereas WIP counterparts have their average index of 0.74 equivalents to crop yield of 6.10MT/ha. The result which is significant at 1% shows that the two locations were above the average crop yield of 4.1MT/ha an indication that shows improvement in crop yield per hectare.

However, between the two locations, KRIP respondents had 0.11MT (110kg) crop yield per ha as ATE, difference above WIP respondents. The closed margin of crop yield per hectare between the locations may not be unconnected with their irrigation farming experience, use of improved seeds and high quality agrochemicals for their production. The finding corroborated with that of Samad and Vermillion (1999) finding which showed no significant differences in the quality of crop product between the irrigation management transfer implemented scheme and the non irrigation management transfer scheme. Conversely, there was significant improvement in agricultural productivity in the schemes

where both management transfer and physical rehabilitation occurred. The implication of the finding is that irrigation schemes agencies and other relevant stakeholders should intensity strategies for water users' full participation in irrigation management as panacea against the deteriorated irrigation system in Nigeria.

### 5.6.1 Overall average impact of PIM on water users' livelihoods

Employing estimated propensity scores for the intervention from the model specification in Table 5.12, the impact of PIM on water users' livelihood estimated with Propensity score Nearness Neighbour (NN) matching estimator and Mahalanobis distance metric to assess the robustness of the results. Matching with replacement was performed which minimized the propensity score distance between the matched comparison units and the treatment unit, each treatment unit being matched to the nearest comparison unit, even if comparison unit was matched more than once. This is very essential in terms of bias reduction.

The result in 5.12 present estimates of the average livelihood impact of PIM on water users. Overall matching estimates shows that PIM improved water users livelihood at 1% level of significance. Overall average matching estimate show that, the PIM intervention has a positive effect on water users livelihood outcomes. The finding indicates that the intervention improved WUs' livelihood by 0.169 coefficients. This mean that if irrigation scheme is selected to be involved in PIM (that is allow WUs to participate in decision making, FC and DCs clearance, payment and collection of water charges, management of conflict among WUs and allocation and distribution of irrigation water) their livelihood outcomes would on average increased to about 17% above the WUs in irrigation scheme not being involved in PIM intervention. The result corroborated with Bhandari *et al.* (2006)

and Kudi *et al.* (2008) studies which indicate that irrigation generated a significant and positive effect on water users' livelihoods (income and crop yield). The implication of the finding is that sustained irrigation schemes provide farmer's livelihood and increase productivity and income generation and food security.

This suggest that PIM has a causal influence on overall livelihood outcomes when individual WUs are matched according to relevant socioeconomic and institutional covariates. Hence, well-articulated intervention for join irrigation management should be executed and sustained for the improvement of WUs livelihoods.

Table 5.12: Propensity score Nearness Neighbour with Mahalanobis Distance Matching showing average treatment effect of PIM on water users' livelihood

| **Outcome variable** | **Coefficient** | **Standard error** | **t** | **P>\| t\|** |
|---|---|---|---|---|
| Livelihood | .1692398 | .0331822 | 5.10 | 0.00 |
| Estimator : NN Matching | | | | |
| Distance metric : Mahalanobis | | | | |
| Number of observations : 593 | | | | |
| Matches: requested : 2 | | | | |
| Minimum : 2 | | | | |
| Maximum : 2 | | | | |

Absolute values of t-statistics on ATE are significant at probability level of 1%Absolute values of t-statistics on ATT are significant at probability level of 1%

**Hypothesis $Ho_2$ Testing**

**Test of hypothesis of Impact of PIM on the livelihood of Water users**

The test to ascertain if the improved livelihood achieved by respondents was a result of their involvement in irrigation management was carried out by means of chow test analysis. The application of chow test statistics involved obtaining the residual sum of square from regression analysis which involved participant and non-participant and pooled as the third

regression.The benefit of the Chow test in this study is that it has enabled the disaggregated analysis to capture the effects of some important factors which would otherwise have been ignored if only a pooled sample model was used. The decision rule sates that if F-chow calculated is greater than F- tabulated then there was project impact on participant otherwise no impact. As shown in Table 5.13 the F-chow calculated value was 221.36, while that of tabulated F value was 2.65 at 5% level of significant. The result indicates that F*-chow calculated was greater than F- tabulated, which implies that PIM had impact on the livelihood outcomes of water users. Therefore the null hypothesis, which stated that PIM has no significant influence of water users livelihood in the study area is rejected.

Table 5.13: Chow tests showing the impact of PIM on KRIP water users' livelihood outcomes

| **Locations** | **Regression** | **Residual sum of square** | **$n_1+n_2$** | **K** | **F - Cal** | **F - Table** |
|---|---|---|---|---|---|---|
| Pooled | 92.294 | 11.547 | 593 | 3 | 221.36 | 2.65 |
| KRIP | 12.358 | 5.891 | | 3 | | |
| WIP | 6.498 | .493 | | 3 | | |

## 5.7 Constraints to Operationalisation of Participatory Irrigation Management

The constraints to effective operationalisation of PIM were identified and categorized into; water users, WUAs official and irrigation agency constrains and were ranked accordingly.

### 5.7.1 Water Users' constraints' to participation in participatory irrigation management

The result in Table 5.14: shows the distribution of water users by their responses on what they considered as constraints their involvement in participatory irrigation management in the study area. The result revealed that degradation of soil was ranked as first constraints as

agreed by 64% of water users in the area. This means that over utilization and poor fertility management of the soil was a major problem to the respondents. Maintenance and improvement of soil fertility under irrigation system requires adequate application of organic manures and efficient water management practices. As such, intensive cropping and regular water application contributes to the depletion of soil fertility and increases erosion and salinity incidences. This was followed by none enabling environment for water users to participate in irrigation management (61.5%). Complete water users' involvement in irrigation management required adequate arrangement for them to have a good atmosphere for participation. Going by this arrangement, water users are supposed to be part and parcel in decision making process and right of water resources usage and maintenance, which was in adequate in the study area.

The non-enabling environment pointed out in the result supports the study conducted by Abubakar (2009) which indicated non enabling environment as constraints to farmer agency joint irrigation management practices. Lack of water users' orientation on O&M ranked third (60.9%) constraints. Irrigation projects in Nigeria were implemented and considered as protective irrigation to secure crop against drought or sudden cessation of rainfall. The idea of sharing responsibilities for irrigation management between agency and farmers was not stated in the plan and implementation stages of the project. Due to global economic crisis government decided to withdrawn from management responsibilities on farm, field canals and distributor canals level and collect some reasonable amount from water users as water charges. This creates dissatisfaction on the side of water users who perceived that irrigation project as social services rendered to farmers for their livelihood enhancement.

Furthermore, water user's poverty level 59.4%, followed by high cost farm inputs 57.2% were also found to be an indicators for effective water users participation in irrigation management. The result suggest that poverty level of water users couple with high cost of farm inputs would seriously cause the stagnation of farming practices especially at farm level. The implication of this finding is that the poorer the water users are the less time they have for participation in O&M, likewise the less chance of purchasing power and access to production inputs resulting in peasantry and less food secured.

About 47% of the respondents perceived in adequate and untimely water release by agency as another challenge to effective participation of water users. Adequate and timely access to irrigation water is of paramount significance in irrigated agriculture, and if interrupted, farmers would lose confidence in their business. The implication to the finding of this study is that that as long as timely and adequate water release is not the major priority of the agency, water users would never have courage to fully participate in irrigation farming activities.

Table 5.14 shows that about 43.1% of the respondents perceived as inadequate skill by water users to carry out O&M as another constraint to effective operation of PIM. Maintenance of irrigation systems requires skills to effectively be done well. The study found that situations exist where water users made some destruction in the course of maintaining the irrigation system. More so high cost of labour was another constraint identified by about 26% of water users in the study area. The mostly affected water users were those who hired labour in almost all their farming operations.

The implication to this finding is that high cost of labour, coupled with low return, gives water users alternative for reducing their farm size. The results support that of McBride (2003), who confirmed that farmers reduce their farm size due to high cost of labour. Less concern of agency/WUAs official was perceived by 22%) of WUs as problems facing their participation in irrigation management. The implication of this finding is that agency personnel and WUAs official are not effective in mobilizing water users. As facilitators of irrigation management transformation, agency personnel and WUAs official should carry water users along to encourage their participation.

Table 5.14: Water Users Constraints to effective Participation in PIM in KRIP

| Water users' Constraints | Frequency | Percent | Rank |
|---|---|---|---|
| Degradation of soil | 208 | 64 | 1st |
| None empowering WUs on system management aspects | 200 | 61.5 | 2nd |
| Low WUs' reorientation on O&M | 198 | 60.9 | 3rd |
| WUs poverty level | 193 | 59.4 | 4th |
| High cost of farm inputs | 186 | 57.2 | 5th |
| Inadequate and untimely water supply | 153 | 47.1 | 6th |
| Inadequate skills by WUs to carry O&M | 140 | 43.1 | **7th** |
| High cost of labour | 85 | 26.2 | 8th |
| Low concern by agency & WUAs officials | 71 | 21.8 | 9th |

### 5.7.2 WUAs official's constraints to participation in PIM

Regarding WUAs officials' constraints to effective participation in PIM, Table 5.15 shows that: lack of sense of ownership by WUAs (86.2%) poor WUAs turnout for FCs & DCs clearance (56.1%) failure of agency to make good arrangement for adequate and timely water supply (66.7%) grievances by WUAs against WUAs official and agency personnel for non-transparency (58.5%) and lastly non participation of capable hand (water users) in WUAs membership (41.7%), were the major constraints on the side of WUAs officials.

These could be address through well planned mobilisation and sensitization workshops. Specifically, failure of irrigation agency to make adequate arrangement for water release on timely bases could also be address through articulated irrigation management stakeholders meeting for decision making. This finding corroborates Arun *et al.*(2012) who opined that unfair election coupled with non transparency, non compliance of water users and failure to make good arrangement for adequate and timely water release were some among the numerous constraints to smooth running of PIM.

Table 5.15:Water usersassociations officials' constraints to participation in PIM in KRIP

| **WUAs officials constraints** | **Frequency** | **Percent** | **Rank** |
|---|---|---|---|
| Poor sense of ownership by WUs | 28 | 86.2 | 1st |
| Poor WUs' turn out for FC & DC clearance | 31 | 86.1 | 2nd |
| Failure of agency to make good arrangement for adequate timely water release. | 24 | 66.7 | 3rd |
| Grievances by WUs against WUAs & agency for non-transparency | 19 | 58.5 | 4th |
| Noninvolvement of capable hand in to WUAs membership | 15 | 41.7 | 5th |

### 5.7.3 Irrigation agency constraints to operation of PIM in KRIP

With respect to agency perceived constraints against operationalisation of PIM, Table 5.16 shows lack of mobility and adequate EAs (91.7%) was ranked first, followed by lack of adequate equipment for main water source maintenance (83.3%), Poor funding (75%) and Agency non enabling environment (67%), noncompliance by WUs to PIM policy (50.0%), Grievances by WUs and WUAs' officials against agency personnel for non-transparency (41.7%) were the challenges encountered by agency against effective water management sharing between water users and irrigation agency. The result is in line with Onyibe (2003)

findings who identified that farmers' were discourage based on poor water distribution and reduction in crop yield as a result of poor budgetary allocation affecting irrigation services delivery. Also Reddy (2005) finding indicates that non decentralization of powers to WUA's and most of the important functions like assessment, collection of water charges and authorization of works remained in the hands of the irrigation department due to agency non enabling environment for effective irrigation management transition. The implication for this is that as long as these identified challenges lingers PIM operation can never succeed.

Table 5.16: Irrigation agency constraints to operation of PIM in KRIP

| **Agency constraints** | **Frequency** | **Percent** | **Rank** |
|---|---|---|---|
| In adequate mobility and EAs | 11 | 91.7 | 1st |
| Inadequate equipment for main source maintenance | 10 | 83.3 | 2nd |
| Poor funding | 9 | 75.0 | 3rd |
| Agency non enabling environment | 8 | 66.7 | 4th |
| Noncompliance by WUs to PIM policy | 6 | 50.0 | 5th |
| Grievances by WUs and WUAs officials against agency personnel for non-transparency | 5 | 41.7 | 6th |

# CHAPTER SIX

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

### 6. I Summary

The study broadly assessed the impact of Participatory Irrigation Management on the livelihood of water users in KRIP and specifically described the socioeconomic characteristics of water users in the study area**;** assessed theextent of water users' involvement in the management of irrigation system in the study area; determined the socio economic factors that influence water users' participation in PIM intervention in the study area ; ascertained the water users' perception of the role of irrigation agencies in the operation of PIM, determine the impact of PIM on the livelihood of WUs and identify the constraints encountered by PIM beneficiaries in the study area. A total of five hundred and ninety three (593) water users' from the sample frame selected for the study using multi-stage, purposive and systematic random sampling techniques. Similarly, 36 and 12 officials from both WUAs and Irrigation agencies within the selected sectors were purposefully selected, using snow ball sampling techniques. Descriptive statistics (mean and percentages) and inferential statistic (multiple regressions, propensity matching score: logistic regressions and independent t-test as well as chow test) were employed to analyses the data.

The result obtained revealed that the average farming experience of water users was 19 and 17 years in KRIP and WIP respectively, while81.2% and 86.6% of the water users had farming as their major occupation. It also shows that 61.5% and 16.1% of WUs in KRIP and WIP registered as members in WUAs. The result obtained indicates that 96 and 92% KRIP and WIP water users participate in PIM at farm level. There was high level of

participation (84%) by KRIP water users in field canal clearance whereas 46% of WIP respondents participate in the exercise. It was indicated that water users in KRIP diversified their cropping practices by planting about eight (8) crops, whereas water users in WIP concentrated on four (4) crops only. The result shows that; farming as major occupation of water users, experience in irrigation farming, Member ship in WUA, Extension Frequency has a positive influence on water user participation in irrigation management at 1% level of significance, whereas age of water user, years in schooling and total farm size influence participation of water users had 1% level of significance but in negative form. Similarly, $R^2$ value of 0.67 indicates the overall contribution of socio economic characteristics to WUs' variation in PIM participation.

The study reveals that, associational role such as leadership capabilities, water users' awareness on WUAs status, productive meeting, voluntary labour contributions and dealing with canal breakers were perceived roles effectively played by WUAs' officials in KRIP, however, perceived not effective according to WUs in WIP. Furthermore, voluntary labour contribution, social audit and transparency and agency's training of water users on how to operate and maintain irrigation facilities were considered not effective in both locations. The overall average matching estimates shows that PIM improved water user's livelihood outcomes at 1% level of significance. Specifically PIM impacted on WUs' income, crop diversification, access to adequate irrigation water, food security and crop yield at 1%.

The respondents indicates that, degradation of soil, none enabling environment for water users to participate in irrigation management, lack of water users' orientation on O&M, water user's poverty level, lack of sense of ownership by WUAs, failure of irrigation

agency to make good arrangement for adequate and timely water supply and non-transparency for WUAs' officials and agency personnel were the major constraints to effective operationalisation of participatory irrigation management.

## 6.2 Conclusion

The result showed that Participatory irrigation management influenced the livelihoods of water users in KRIP thereby increasing their access to irrigation water, food security and crop yield and by attainment level of food security and possession of minimum farm and nonfarm assets. However, wrong perception on irrigation management responsibilities sharing among three key stakeholders (farmers, WUAs officials and irrigation agency) were found to inhibit successful operation of PIM. This implies that WUs perceived WUAs and Agency officials as less concern about the real take off of PIM, and were not transparent in term of financial audit. On the other hand, both WUAs and agency officials perceived WUs as not ready and cooperative in real operationalisation of PIM. Upon all these perceptions mentioned, PIM played a significant role on water users' participation at Field canals and Distributary canals clearance, resolving conflict, payment and collection of water charges were encouraging. Non enabling environment for water users and agency personnel, water users poverty level, poor funding of irrigation agency, were the most pressing constraints to the operationalisation of PIM in the study area.

## 6. 3 Recommendations

In spite of the positive impacts of PIM on diversified crop production and other sources of income, assets possession, food security, increased crop yield and accessibility to adequate irrigation water highlighted in the result, there a number of factors which still obstructed

the water users from reaching the long term objectives of PIM. Based on the finding of this study, the following recommendations were proffered to tackle the identified obstacles to successful PIM operation in the study area.

i. Despite these gaps in the level of participation between KRIP and WIP, still more effort for mobilization and strengthened water users for group formation and participation in decision making process needs to be made by WUAs, irrigation agencies and NGOs in KRIP. Whereas for WIP the result could serve as baseline for PIM implementation

ii. There was high level of participation (84%) by KRIP water users for field canal clearance whereas only 46% of WIP respondents participate in the exercise. Similarly, in distributaries canal de-silting and de-weeding 52% and 23% level of participation in KRIP and WIP respectively was reported. Agency and WUAs officials of both locations should mobilize water users to improve on FCs clearance and DCs de-silting and de-weeding especially in WIP location.

iii. Measures such as WUs' empowerment and assigning appropriate responsibilities should be taken by irrigation management agencies to carry water users along in every aspect especially decision making on irrigation management handover.

iv. The finding of the study shows that age of water user, years in school and total farm size had negative influences on WUs participation in irrigation management. More sensitization and mobilisation should be given to aged, highly educated and large farm holder water users by irrigation agencies to ensure their compliance to PIM arrangement.

v. Effort to make discussion with WUAs officials and competent authorities and voluntary labour contribution by WUs, social audit and transparency among WUAs and agency official were perceived not effective according to respondents. It is advised that more

reorientation programmes should be promoted for major stakeholders in the study area to effectively remedy the situation.

vi. It is suggested that irrigation agencies, extension and irrigation management research institutions should provide system maintenance manuals, guides, posters and mobile cinema should be used to mount reorientation campaign for system maintenance across the study area, to reduces the problems of soil degradation and seepage as result of unskillful clearance of FCs.

vii. Water users should ensure promptness in the payment of water dues and agency should portray transparency and accountability on the money received as water charges to help agency in solving its pressing financial problems. More so, funding of irrigation agency by responsible authorities should adequately be sustained before the complete take over by WUs.

viii. Irrigation agency personnel and WUAs officials should change their wrong perception against each other. While agency staff should consider WUs as an important resources , similarly WUs should as well take the advantage technical skills of the agency staff in better management of irrigation system and improve on their agricultural production. This can only be possible when frequent meeting among these parties are well organised.

### 6.4 Contribution to Knowledge

i. There was high level of participation by WUs in FCs clearance (84%,) DCs de-silting and de-weeding (52%), membership in WUAs (61.5%), conflict management among water users' (56%) payment and collection of water charges (74%) in KRIP

ii. Water users' income sources increased by 8% in KRIP

iii. Water users' access to adequate and timely irrigation water in KRIP increased by 48%

iv. Respondents' food security livelihood indicator shows that in KRIP where PIM was implemented, WUs were 24% more food secured above their counterparts in non PIM intervention irrigation schemes.

v. The crops yield of WUs in KRIP increased by 0.11MT (110kg) per ha which is about 11% among the beneficiary water users.

### 6.5 Suggestion for Further Study

From the finding of this study it is suggested that further research should be carried out on:

1. Analysis of the stage of Participatory Irrigation Management/Irrigation Management Transfer in HJRBDA.
2. Comparative evaluation of the performance of Irrigation Infrastructures in PIM and non PIM Implemented Irrigation Schemes in HJRBDA
3. Examination of water users' conflict in Kano River Irrigation Project (KRIP): Causes and Mitigating Strategies.

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## APPENDIX I

**Water Users Questionnaire: KRIP [ ] Watari Irrigation Project [ ]**

Dear Sir/Malam,

I am a postgraduate student of Agricultural Economics & Rural Sociology Department, Ahmadu Bello University, Zaria, working on the above topic. Please, provide all the necessary information required in the questionnaire. All information will be treated with utmost confidentiality and will strictly be used for research purpose.

**A. Background information**

1. Name of interviewer:...…….…… GSM No.……..……
2. Name of respondent: ...…….……..… GSM No……..…
3. Name of the sector (village)...…….…..……...……...……
4. Date of interview: ……...…….

**B. Socioeconomic characteristics of water users in the study area**

5. What is your age? .....
6. Please indicate your sex: Male ( ) Female ( )
7. What is your Marital status:

   (i) Single ( ) (ii) Married ( ) (iii) Divorced ( ) (iv) Widow ( )
8. What is your household size? ----------
9. Please indicate your Household head type:

   i. Male headed ( ) ii. Female headed ( )
10. How is the highest level of education you attained?

    (i) No formal education ( ) (ii) Arabic/Islamic education ( )

    (iii) Primary Education ( ) (iv) Secondary education ( )

    (v) Tertiary education ( )
11. How many years did you spend in formal education? ……years
12. How many years have you been in irrigation farming?.....years
13. Is farming your major occupation? Yes ( ) No ( )
14. If yes, which types of farming do you engage?

    i. Rain feed ( ) ii. Irrigation ( ) iii. Both ( )

15. Please indicate from below other activities you engaged in?

(i) Civil service ( ) (iv) Weaving ( )

(ii) Artisans ( ) (v) Trading ( )

(iii) Tailoring ( ) (vi) Animal fattening ( )

(vii) Others……

16. What is your total income per annum N……..……..

17. Do you have contact(s) with project extension agents as regards participatory irrigation management? Yes ( ) No ( )

18. If yes, how often or how many times?

(i) Fortnightly ( ) (ii) Once a month ( ) (iii) Once in three months ( )

(iv) Once in more than three months ( )

19. Are you satisfied with the visits of Extension agents? Yes ( ) No ( )

20. Do you belong to any association/co-operative society? Yes ( ) No ( )

21. If yes, how many associations/co-operative societies do you belong? .....

22. Do you belong to water user association? Yes ( ) No ( )

23. If yes how many years have you spent in water user association? ……..…….years

24. How do you acquire agricultural land?

i. Purchased ( ) ii. Rentage ( ) iii. Inheritance ( ) iv. Share cropping (

25. Please state the total hectares (ha) you have under;

i. Irrigation ……..…ha(s) ii. Upland …..……. ha(s) iii. Total...…….. ha(s)

26. Indicate the proportion of agricultural land cultivated in both wet and dry season

| S/No. | Proportion of land cultivated | Wet season( ha) | Dry season( ha) |
|---|---|---|---|
| i. | All land is cultivated | | |
| ii. | Three quarters | | |
| iii. | Half the land | | |
| iv. | Quarter of land | | |
| v. | Other (define) | | |

27. If not all land is cultivated during dry season, then what are the reasons for that?

i. Lack/inadequate finance ( ) ii. Lack/inadequate water ( ) iii. Salinity effect ( )

iv. Abundant land ( ) v. Aquatic weeds occupied in the farm ( )

28. a. What maximum size do you

i. rent in ……..… ha(s); ii. rentout……..….. ha(s)

b. How much are you rent in/rent-out hectare of land in;

i. Dry season N …….. ii. Wet season N …..…….

29. State the location of your farm land under irrigation scheme;

i. Head ( ) ii. Middle ( ) iii. Tail end ( )

30. How is your current land-use intensity compared to six years ago?

a) improved ( ) b) remained the same ( ) c) worsened ( )

**C. Extent of water users' involvement in the management of irrigation system**

31. How much do you pay your water charges to irrigation agency? ..... Naira/ha

32. To whom did you pay your water charges?

i. WUAs officials ( ) ii. Irrigation agency personnel ( ) iii. Court ( )

33. Do you spend too much time on irrigating your farm plots? Yes ( ) No ( )

34. If Yes, or No, tick as appropriate.

| **If Yes:** | | | **If No:** | | |
|---|---|---|---|---|---|
| **S/No** | **Reasons** | **Tick** | **S/No** | **Reasons** | **Tick** |
| i. | Because I'm at the tail end of block | | i. | Because I'm at the top of block | |
| ii. | DC and FC are not in good condition | | ii. | DC and FC are in good condition | |
| iii. | Water control structures are not in good condition | | iii. | Water control structures are in good condition | |
| iv. | Many farmers irrigate at the same time | | iv. | Farmers schedule time for irrigating crops | |
| v. | Low and untimely discharge of water | | v. | Adequate and timely discharge of water | |
| vi. | More lands are cultivated | | vi. | There are more fallow land | |

35. How are you now engaged in your farm since the introduction of the PIM project in 2006 - 07?

a) Full time ( ) b) Part time ( )

36. Please indicate the extent/level of your participation in the following Irrigation management practices

| S/No. | Irrigation management practices | Extent/Level of participation | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 1. | Decision making process | | | | | |
| 2. | Farm level operation | | | | | |
| 3. | Field Canal clearance | | | | | |
| 4. | Distributary Canal clearance | | | | | |
| 5. | Main Canal clearance/maintenance | | | | | |
| 6. | Membership in WUAs | | | | | |
| 7. | Conflict resolution | | | | | |
| 8. | Payment and collection of water charges | | | | | |
| 9. | Record keeping | | | | | |

5 = Very high, 4 = High, 3 = Moderate, 2 = Very low and 1 = Not at all

37. Do you work on the farm every day? Yes ( ) No ( )

38. If "no", how many days per week do you work on your farm? ……..Days

39. On average, how many hours do you work per day? ……..……..Hrs/day

**D. Factors that influence water users participation in PIM intervention/Irrigation Management**

40. Did you keep physical and financial records of your farm? Yes ( ) No ( )

41. If "yes", have you receive training on how to keep these records? Yes ( ) No ( )

42. Which organization(s) trained you on how to keep farm record?

i. ……..

ii. …….

iii. ……..……

43. Did your farm input expenditure increased or decreased since the implementation of PIM?

a) Increased ( ) b) Decreased ( ) c) Remained unchanged ( )

44. For any of the above give your reason(s)

| **State of farm input expenditure** | **Reasons for or no change on farm input expenditure** |
|---|---|
| a. Increased | i. ……..<br>ii. …… |
| b. Decreased | i. ……..…….<br>ii……..…….. |
| c. Remained unchanged | i…….<br>ii……...……. |

**D. Water Users perception of WUAs performance and irrigation agencies' role in operation and maintenance of irrigation infrastructure**

45. Please assess the WUAs Performance in your irrigation scheme

| **Activities** | **Level of Performance** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | **1** |
| **A. Level of participation** | | | | | |
| Leadership capability | | | | | |
| Members awareness about WUA status | | | | | |
| Productive meetings | | | | | |
| Voluntary physical/labour contribution | | | | | |
| Voluntary financial contribution | | | | | |
| Social Audit/ Transparency | | | | | |
| **B. Operation & Maintenance**<br>Removal of silt and weeds | | | | | |
| Repairs/maintenance of structure | | | | | |
| Protection of structure | | | | | |
| Dispute management | | | | | |
| **C. Water Management**<br>Adequate and timely water supply | | | | | |
| Information about water distribution | | | | | |
| Efforts to save water | | | | | |
| **D. Financial management**<br>Fund generation | | | | | |
| Utilisation of O&M fund | | | | | |
| Recovery of irrigation fees (when applicable) | | | | | |
| Financial audit | | | | | |
| **E. Organizational Linkage**<br>Adequate linkages with other WUAs | | | | | |
| Information and communication | | | | | |
| Discussion with competent authority | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

46. How do you perceived the role of the irrigation agency on Irrigation management or PIM intervention in your irrigation scheme?

| **Roles of irrigation agency in irrigation management** | **Respondents' Perceptions** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | 1 |
| i. Mobilizing farmers to form WUAs | | | | | |
| ii. Training farmers how to operate and maintain irrigation facilities | | | | | |
| iii. Dealing with channel breakers | | | | | |
| iv. Punishing whoever fail or refuse to pay water charges | | | | | |
| v. Helping farmers to resolve conflict | | | | | |
| vi. Involving farmers decision making process | | | | | |
| viii. Ensuring that water users associations collect receipt after payment of water charges | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

47. How effective and efficient irrigation management at certain level of water delivery?

| **Roles of irrigation agency in irrigation management** | **Respondents' Perceptions** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | 1 |
| i. Field Canal | | | | | |
| ii. Distributary Canal | | | | | |
| iii. Main Canal | | | | | |
| iv. Sector turn out | | | | | |
| v. Water Control Structures | | | | | |
| vi. Field drainages | | | | | |
| viii. Service road | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

**F. Benefits derived from of Participation in Irrigation Management**

48. Use the table below to indicate the perception of water users on the benefits derived from participation in PIM intervention.

| S/No. | Perception of benefits derived from PIM intervention | Perception of Agency | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 1. | Reducing the financial burden of irrigation farming | | | | | |
| 2. | Cordial relationship between the agency staff and water users | | | | | |
| 3. | Improvement on farmers' crop output (yield). | | | | | |
| 4. | More women involvement in irrigation management activities | | | | | |
| 5. | Improvement in the performance of irrigation scheme | | | | | |
| 6. | It facilitate conflict management among water users | | | | | |
| 7. | Motivating water users to increase their farm land | | | | | |
| 8. | It generate other development activities | | | | | |
| 9. | Increased in water users income | | | | | |
| 10. | Increased food security | | | | | |

5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1= Strongly disagree

**G. Impact of PIM/Irrigation management involvement on the Livelihood of water users**

**Access to irrigation water**

49. What are your source(s) of water for irrigation?

i. Dam ( ) ii. Pond ( ) iii. Dug well ( ) iv. Spillover from the Dam ( )

v. Other specify ……..

50. How do you access irrigation water?

i. My own well ( ) ii. Member ship in WUAs ( )

iii. Free access ( ) iv. Through payment of water charges ( )

v. Other means specify ---------- ( )

51. How adequate is the irrigation water you are using?

i. Very adequate ( ) ii. Adequate ( ) iii. Partially adequate ( )

iv. Not adequate ( ) v. Not at all ( )

52. How often is water accessible for irrigating your farm?

i. Very often ( ) ii. Often ( ) iii. No opinion ( )

iv. Rarely ( ) v. Very rare ( )

53. Please indicate with reason(s) what time you normally irrigate?

| **Time** | | **Reason(s)** |
|---|---|---|
| i. In the morning | ( ) | ---------- |
| | | ---------- |
| | | ---------- |
| ii. In the afternoon/Evening | ( ) | ---------- |
| | | ---------- |
| | | ---------- |
| iii. In the night | ( ) | ---------- |
| | | ---------- |
| | | ---------- |

**Food Security**

54. Please indicate your current level of your household food security compared to 6 years back:

a) more food secured ( ) b) same ( ) c) less food secured ( )

55. How many meals does your household adequately consumed per day?

a) three ( ) b) two ( ) c) one ( ) d) sometimes no meal at all ( )

e) others *(*specify*)* ……..……..……

56. State the quantity of all farm output produced in the year 2013 ……...…….. Bags.

57. State the quantity of non-consumption needs in the year 2013 ……...……. Bags.

58. State the quantity of food consumed by the household per day ……..…….Measure

59. State the quantity of food require the household per day ……....…..…….. Measure

60. How did your household get their food items?

a) Buy ( ) b) grow ( ) c) both a &b ( )

61. Indicate the main ingredients and sources of diet required and/or consumed in your household:

| **S/No.** | **Main ingredients** | **Tick** | **Quantity consumed per day (**kg/N**)** | **Quantity required per day (**kg/N**)** | **Source of ingredients** | |
|---|---|---|---|---|---|---|
| | | | | | Own production | Buying from market |
| 1. | Maize, G/Corn & millet (corn) | | | | | |
| 2. | Rice | | | | | |
| 3. | Wheat | | | | | |
| 4. | Tomato/Pepper | | | | | |
| 5. | Cowpea | | | | | |
| 6. | Vegetables (leafy) | | | | | |
| 7. | Fruits | | | | | |
| 8. | Animal protein | | | | | |

NB for Tomato/Pepper, Vegetables, Fruits and Animal Protein should be valued in Naira

62. What is your input cost, output and prices did you receive for your crops for both wet and dry seasons?

| S/ No | Crops | Wet season | | | | Dry season | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Production cost | Output | Price/ Unit | Farm size | Production cost | Output | Price/ Unit | Farm size |
| 1. | Rice | | | | | | | | |
| 2. | Maize | | | | | | | | |
| 3. | Wheat | | | | | | | | |
| 4. | Tomato | | | | | | | | |
| 5. | Onion | | | | | | | | |
| 6. | Cabbage | | | | | | | | |
| 7. | Cucumber | | | | | | | | |
| 8. | Watermelon | | | | | | | | |
| 9. | Others | | | | | | | | |

**Asset possession:**

63. Please indicate from the table below the valued properties currently owned by the household:

| S/N | Assets | Number/Size | Year purchased | Monetary value (N) |
|---|---|---|---|---|
| 1. | Concrete house | | | |
| 2. | Mud house with zinc roof | | | |
| 3. | Mud house with wood roof | | | |
| 4. | Tractors | | | |
| 5. | Trucks/Pick-up | | | |
| 6. | Cars | | | |
| 7. | Bus | | | |
| 8. | Motor cycle | | | |
| 9. | Bicycle | | | |
| 10. | Farm land | | | |
| 11. | Siphon tubes | | | |
| 12. | Water pump machine | | | |
| 13. | Farm tools (hoe, rake& sickle) | | | |
| 14. | TV: Colour( ) B&W ( ) | | | |
| 15. | Radio | | | |
| 16. | Mobile hand set | | | |

64. List the income generating activities you engage in your area

i. …… iv ……

ii. ……. v. ……

iii. ……. vi. ……

65. How much did you spend on your children school fee per annum? N ……..

66. How much did you spend on your house hold health care per month? N……..……

67. Please indicate from the table below your accessibility to the following livelihood assets:

| **1. Access to Social Capital** | Water users response | |
|---|---|---|
| | Yes | No |
| i Do you have the opportunity to belong WUAs | | |
| ii. Have you worked together as group | | |
| iii. Do you have the opportunities for every position in your associations | | |
| **2. Access to Human Capital**<br>Do you receive the following training/services from your irrigation agency? | Yes | No |
| i. Extension services | | |
| ii. Record keeping | | |
| iii. Water management | | |
| iv. Timely water discharge | | |
| v. Adequate water discharge | | |
| iv. Financial management | | |
| v. Soil management | | |
| vi. Crop protection | | |
| **3. Access to Natural Capital** | | |
| i.Do you have access to land? | | |
| ii. Is the land easily available? | | |
| iii. Land Tenure System: | | |
| a. Inheritance | | |
| b. Purchased | | |
| c. Share cropping | | |
| d. Leased | | |
| **4. Access to Physical capital**<br>Please indicate the availability of the following in your area | | |
| i. Markets | | |
| ii. Service road | | |
| iii. Night storage | | |
| iv. Warehouse | | |

| **5.Access to Financial Capital** | **Amount** | **Water users responses** | | | |
|---|---|---|---|---|---|
| What are your sources of credit | **(N)** | V/Adequate | Adequate | Inadequate | Not at all |
| i. Banks | | | | | |
| ii. Cooperatives | | | | | |
| iii. Local money-lenders | | | | | |
| iv. Relatives | | | | | |
| v. Personal savings | | | | | |
| vi. Contractors | | | | | |
| vii. Government subsidies | | | | | |

**H. Constraints to participation in irrigation management intervention**

68. List the constraints to effective operation and maintenance of irrigation infrastructure in your area:

i. ----------

ii. ----------

iii. ----------

iv. ----------

69. Please tick the challenges encountered in PIM intervention / operation and maintenance of irrigation infrastructure in your area:

| **Challenges of PIM** | **Tick** |
|---|---|
| i. Non enabling environment for the agency | |
| ii. Non enabling environment for WUs | |
| iii. Politicizing the WUAs | |
| iv. Noncompliance by WUs to the new irrigation management policy (PIM) | |
| v. Lack of sense of ownership by WUs | |
| vi. Lack of adequate skills by WUs to carry out O&M of the system/infrastructure | |
| vii. Low concern by agency and WUAs officials | |
| viii. Corruption by agency and WUAs officials | |
| ix. High level of poverty which constraint WUs to adopt PIM technologies | |

70. What general suggestions can you give to improve these challenges?

i. ----------

ii. ----------

iii. ----------

iv. ----------

v. ----------

## APPENDIX II

**Questionnaire for WUAs officials of KRIP ( ) / Watari Irrigation Project ( )**

1. Name of the sector (village).....……..……..…….
2. Name of the respondent……
3. Age ……..…….
4. Educational level:
   (i) No formal education ( ) (ii) Arabic/Islamic education ( )
   (iii) Primary Education ( ) (iv) Secondary education ( )
   (v) Tertiary education ( )
5. How many years did you spend in formal education? ……years
6. Please indicate your sex: Male ( ) Female ( )
7. What is your Marital status:
   (i) Single ( ) (ii) Married ( ) (iii) Divorced ( ) (iv) Widow ( )
8. What is your household size? ----------
9. Please indicate your Household head type: i. Male headed ( ) ii. Female headed ( )
10. Is farming your major occupation? Yes ( ) No ( )
11. If yes, which types of farming do you engage? i.Rain feed ( ) ii.Irrigation ( ) iii.Both ( )
12. How many years have you been in irrigation farming?.....years
13. Name of the association (WUAs) …...…….
14. Number of members of the associations …….
15. Years of member ship in WUA ……..
16. Rank in the association ……..
17. Tenure and years in office …….
18. Status criteria i. election ( ) ii. Nomination ( ) iii. Self ( ) iv. ( )
19. What is the total area (acres) under command? .....acres
20. How frequent did your association held a meeting?
    i. Monthly ( ) ii. Quarterly ( ) iii. Occasionally if needs a raise ( )
    iv. Twice in a year ( ) v. Once in a year ( )

21. What are the total water charge did you collect in a season? ……..…….Naira
22. Did you experience major water distribution problems in your command? Yes ( ) No ( )
23. If yes indicate from the list below the major problems
    i. Insufficient water supply ( )
    ii. Deficiency of water control structures ( )
    iii. Late water release by the agency ( )
    iv. Non proper arrangement for water distribution ( )
    v. Poor WUs/WUAs members/Agency personnel cooperation ( )
24. How much did you remit to irrigation agency? ..... ..... Naira
25. How do you perceived the role of agency on PIM intervention in your irrigation scheme?

| **Roles of irrigation agency in irrigation management** | **Respondents' Perceptions** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | 1 |
| i. They mobilized farmers to form WUAs | | | | | |
| ii. They train farmers O&M of irrigation facilities | | | | | |
| iii. They deal with channel breakers | | | | | |
| iv. They punish whoever fail or refuse to pay water charges | | | | | |
| v. They help farmers to resolve conflict | | | | | |
| vi. They invite farmers to any meeting regarding to decision making process | | | | | |
| viii. They ensure that water users associations collect receipt after payment of water charges | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

26. Please use the format below to assess the WUAs members Performance in your irrigation scheme management

| Activities | Level of Performance | | | | |
|---|---|---|---|---|---|
| | 5 | 4 | 3 | 2 | 1 |
| **A. Level of participation** | | | | | |
| Productive meetings | | | | | |
| Voluntary physical/labour contribution | | | | | |
| Voluntary financial contribution | | | | | |
| Respect the officials | | | | | |
| Timely payment of water due | | | | | |
| Meeting attendance | | | | | |
| **B. Operation & Maintenance**<br>Removal of silt and weeds | | | | | |
| Repairs/maintenance of structure | | | | | |
| Protection of structure | | | | | |
| Dispute management | | | | | |
| **C. Water Management**<br>Water sharing | | | | | |
| Efforts to save water | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

**Constraints to participation in irrigation management intervention**

27.. List the constraints to effective operation and maintenance of irrigation infrastructure in your area:

i. ----------

ii. ----------

iii. ----------

iv. ----------

## APPENDIX III

**Questionnaire for Management of KRIP ( ) / Watari Irrigation Project ( )**

27. Name of the respondent……

28. Qualification…….

29. Status……

30. Working experience (years) ……

31. Are you aware of the PIM intervention? Yes ( ) or No ( )

32. Is PIM intervention taking place in your scheme? Yes ( ) or No ( )

33. If yes, what are the evidences of PIM intervention?

i…….....

ii……..…….

iii……..……..

iv……..……..

34. Do you think the intervention is in the right direction towards meeting its objectives?

Yes ( ) No ( )

9. Use the table below to indicate the perception of agency on the benefits derived from PIM intervention.

| S/No. | Perception of benefits derived from PIM intervention | Perception of Agency | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| 1. | PIM reduces the financial and management burden of agency | | | | | |
| 2. | PIM enhances the cordial relationship between the agency staff and water users | | | | | |
| 3. | PIM help water users developed sense of ownership on their irrigation scheme | | | | | |
| 4. | More women are involve in irrigation management activities | | | | | |
| 5. | There is improvement in the performance of irrigation scheme because of PIM intervention. | | | | | |

6 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1= Strongly disagree

10. Did water users in your scheme participate in any of the following practices or technologies introduced by the PIM project team? *(Tick Yes or No)*

| **Area of intervention** | **No** | **Yes** |
|---|---|---|
| i. Facilitating Group formation | ( ) | ( ) |
| ii. Decision making process | ( ) | ( ) |
| iii. Facilitating sustainability of irrigation management | ( ) | ( ) |
| iv. Facilitating credit sourcing | ( ) | ( ) |
| v. Facilitating conflict management | ( ) | ( ) |

11. How WUs are engaged in their farm since the introduction of the PIM project?

a) Full time ( ) b) Part time ( )

12. Please indicate the level of water users participation among the following PIM Intervention mode

| **PIM intervention modes** | **Level/extent of participation in PIM** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | **1** |
| Farm operation | | | | | |
| Field Canal clearance | | | | | |
| DC clearance | | | | | |
| MC clearance | | | | | |
| Decision making | | | | | |
| Membership in water user association | | | | | |
| Resolving conflict between water users | | | | | |
| Farm record keeping | | | | | |
| Payment of water charges | | | | | |
| Collection of water charges from farmers | | | | | |

13. List the constraints to effective operation of PIM in your scheme:

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14. Please use the table below to provide information on WUAs' adequacy in your scheme.

| **Number of WUAs** | | **Estimated number of WUAs members** | |
|---|---|---|---|
| Projected no. of WUAs | Actual no. of WUAs | Projected no. of WUAs members | Actual no. of WUAs members |
| | | | |

15. Please use the format below to assess the WUAs Performance in your irrigation scheme

| **Activities** | **Level of Performance** | | | | |
|---|---|---|---|---|---|
| | **5** | **4** | **3** | **2** | **1** |
| **A. Level of participation** | | | | | |
| Leadership capability | | | | | |
| Members awareness about WUA status | | | | | |
| Productive meetings | | | | | |
| Voluntary physical/labour contribution | | | | | |
| Voluntary financial contribution | | | | | |
| Social Audit/ Transparency | | | | | |
| **B. Operation & Maintenance** | | | | | |
| Removal of silt and weeds | | | | | |
| Repairs/maintenance of structure | | | | | |
| Protection of structure | | | | | |
| Dispute management | | | | | |
| **C. Water Management** | | | | | |
| Equity in water distribution | | | | | |
| Efforts to save water | | | | | |
| **D. Financial management** | **5** | **4** | **3** | **2** | **1** |
| Fund generation | | | | | |
| Utilisation of maintenance and operation fund | | | | | |
| Recovery of irrigation fees (when applicable) | | | | | |
| Financial audit | | | | | |
| **E. Organizational Linkage** | | | | | |
| Linkages with other WUAs | | | | | |
| Information and communication | | | | | |
| Discussion with competent authority | | | | | |

Very effective = 5, effective = 4, no opinion =3, less effective =2 and not effective =1

16. Please tick from the following challenges encountered in PIM intervention

| **Challenges of PIM** | **Tick** |
|---|---|
| i. Non enabling environment to the side of agency | |
| ii. Non enabling environment to the side of WUs | |
| iii. Politicizing the WUAs | |
| iv. Noncompliance by WUs to the new irrigation management policy (PIM) | |
| v. Lack of sense of ownership by WUs | |
| vi.Lack of adequate skills by WUs to carry out O&M of the system/infrastructure | |
| vii. High level of poverty which constraint WUs to adopt PIM technologies | |

17. What general suggestions can you give to overcome these challenges?

i. ----------
ii. ----------
iii. ----------
iv. ----------
v. ----------