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Integrated Water Resources Management for Poverty Alleviation: A Case of Pangani Basin, Tanzania

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Abstract

The research aimed at assessing the implementation of IWRM for poverty alleviation and improved livelihood. Community members were asked to categorize their households into different wealth status. Results indicate that while agriculture has remained to be the main economic activity, people's livelihoods had been improved. Some of the indicators of improved livelihoods identified by the study include food security, income and possession of household assets. The study found that before IWRM households in the study area had enough food for average of 6.5 months, but after IWRM implementation the number had increased to average 8.7 months. Income has also increased after the implementation of IWRM. However, women were found to be lagging behind men. One of the plausible explanations to this observation is the low status of women which results in inadequate ownership of various resources, including land. Based on the findings in the study, it is concluded that IWRM is important for both poverty alleviation and improved livelihood and therefore, it is recommended that where IWRM is yet to be implemented, measures should be put in place to ensure its implementation. Furthermore, adequate community participation is paramount in order to positively change the lives of the people and register significant results notably that of women who have been found to be lagging behind men.

List of Acronyms and Abbreviations

DFID	UK Department for International Development
FAO	Food and Agriculture Organization
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
MDG	Millennium Development Goals
NGO	Nongovernmental Organization
PEP	Poverty and Environment Partnership
SACCOS	Savings and Credit Cooperative Societies
URT	United Republic of Tanzania

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CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Background

Water is a critical ingredient for economic development and a basic natural resource that sustains life on earth. It is also an essential component of all ecosystems and a basic element for life and health. Two point five percent of the total amount of water on the earth is fresh but a large portion of the global freshwater is not accessible, as they exist as glaciers and continental ice sheets (Donahue and Johnson, 1998). However, hydrological studies indicate that at global scale the amount of available water (underground aquifers, rivers and lakes) is enough to support the world population. Water problems arise from the heterogeneous distribution spatially or temporally of water resources and they are prominent in developing countries. The availability of water is critical not merely for health reasons, but also for economic development (WHO and UNICEF, 2006). Uneven distribution of water resources is the reason behind some areas experience water shortages while others enjoy an ample supply of water. The challenge of water availability has been adequately addressed in the Millennium Development Goals (MDGs) and many other international and local resolutions. While adequate availability of water is important for ensuring that countries meet or come close to various MDGs, it will be difficult to realize the goals in the absence of proper water resources management. There is general consensus that improved efficiency in the water sector requires better water resources management (CapNet and GWP, 2008).

The contribution of water resources management to poverty reduction and improved livelihood cannot be overemphasized. The importance of ensuring that the poor have access to safe drinking water and improved sanitation has been prominent in international discussions and specific targets have been included in the internationally agreed MDGs. However, the contribution of water resources management to poverty is more than ensuring adequate availability of drinking water and sanitation. Water is essential for improving health and livelihoods of the poor, ensuring wider environmental sustainability and eradicating hunger. The importance of water resources management for poverty alleviation was also identified in the Dublin Principle[1]. Under the fourth guiding principle which is concerned with water as an economic good, it was recommended that priority be given in water resources management and development for poverty alleviation (UN, 1992).

Against the above explanation, water resources management is important in order to reduce disease burden, empower women, poverty alleviation and realize sustainable development. The mentioned benefits can only be achieved through a holistic approach to water resources management as opposed to single purpose approach. Integrated water resources management (IWRM) is an articulation to the belated concern on water resources management. IWRM refers to a systematic process for the sustainable development, allocation and monitoring of water resource use in the context of social, economic and environmental objectives (Cap-Net, 2006). It is a holistic and cross-sectoral approach and therefore in stark contrast to the traditional sectoral approach that has been adopted by many countries.

[1] The Dublin Conference was held in 1992. It came up with four principles which continue to shape, guide and influence decisions and practices in water and the environment.

In order to contribute to poverty alleviation and improved livelihood, water resources management should not be based on immediate needs and interests but it should be a continuous devotion (Abu-Zeid, 1998). IWRM will, therefore, help to ensure continuous devotion since an important feature of this approach is to focus on proper water usage and development of water resources through efficient and environmentally sound manner (UN, 1992). Water resource management entails socially efficient and sustainable use of water resources for not only meeting water demands but also poverty reduction. IWRM calls for environmental protection which is paramount for poverty alleviation. Terrestrial ecosystems in the upstream areas of a basin are important for rainwater infiltration, groundwater recharge and river flow regimes (CapNet, 2002). Aquatic ecosystems produce a range of economic benefits, including such products as timber, fuel wood and medicinal plants, and they also provide wildlife habitats and spawning grounds. The ecosystems depend on water flows, seasonality and water-table fluctuations and are threatened by poor water quality. Land and water resources management must ensure that vital ecosystems are maintained and that adverse effects on other natural resources are considered and where possible reduced when development and management decisions are made.

IWRM has the potential to reduce poverty and contribute to livelihood through ensuring the continuity in water flows and maintaining environmental integrity. User communities are the ones who benefit from "free" common resources such as fuel wood, water, fisheries, and fruits. They can also contribute to ecosystem degradation through over-exploitation. IWRM can help to safeguard an "environmental reserve" of water commensurate with the value of ecosystems to human development. Destruction of ecosystems penalizes the poor most. In this premise, water resources management is critical for poverty alleviation.

The basis for IWRM is that many different uses of water resources are interdependent and have to be adequately involved in water resources management. For example, high irrigation demands and polluted drainage flows from agriculture mean less freshwater for drinking or industrial use. Contaminated municipal and industrial waste water pollutes rivers and threatens ecosystems. If water has to be left in a river to protect fisheries and ecosystems, less can be diverted to crops. Employing the IWRM approach can ensure a healthy ecosystem, which is critical for such activities as agriculture, fishing and grazing. Furthermore, meaningful involvement of users has the potential to register desired outcomes such as increased availability of water, improved livelihood and poverty alleviation.

Various strategies are employed to alleviate poverty. Among them is improving access to agricultural water and its use (IWMI, 2007). These strategies basically target the livelihood gains of smallholder farmers by securing water access through water rights and investments in water use. Furthermore, IWRM has the potential to allow multiple use systems operated for domestic use, crop production, aquaculture and agroforestry. These multiple uses of water not only improve water productivity but also they reduce poverty (*ibid*).

IWRM means, therefore, that all the different uses of water resources are considered together. Water allocations and management decisions consider the effects of each use on the others. Users are able to take account of overall social and economic goals, including the achievement of sustainable development. However, the extent to which implementation of IWRM is contributing to poverty alleviation is yet to be ascertained. For instance, it is not clear the extent to which the

different strategies we have as a country in regard to water articulate water as a medium for poverty alleviation. This assessment is particularly important given the fact that Tanzania, just like other countries, has endorsed the UN MDGs is also implementing IWRM. In the present study, poverty alleviation would be related to agricultural activities, fisheries and livestock keeping. Furthermore, accessibility to water (including walking distances) has also been assessed in relation to poverty alleviation. In the context of IWRM, these had been considered before and after the implementation of IWRM in the Pangani Basin.

1.2 Statement of the Problem

For long time water resources management has been carried out in isolation from other resources such as land and forests. Quite often the focus has been placed on a single purpose of water use. However, scholars and policy makers have come to realize that this approach has a number of shortcomings and it needs to be replaced by a more realistic approach. Integrated approach to water resources management (IWRM) is an expression to this belated concern. Major problems that necessitated IWRM adoption include the following:

- Lack of management integration;
- Use of 'sectoral' management approaches (forest, land and water);
- An increasing number of stakeholders interested in water resources but lacking forum for participation;
- Existence of both formal and informal institutions governing water management which are neither compatible nor harmonized, thereby creating legal pluralism; and
- Marginalization of women, particularly under customary water management arrangements.

Under this situation neither sustainable water management nor equity in water distribution could be achieved. Rather, water shortage and water use conflicts were common. People's livelihood strategies were jeopardized since more time had to be spent in fetching water and little time remained for agricultural activities. Competition and power struggles for irrigation water became severe. Based on IWRM guiding principles (community participation, effective water management to sustain life, women empowerment and commoditization of water to get money for water sources protection), most of these problems can be mitigated and people's livelihood improved. Among the efforts which have been taken to implement IWRM in Pangani Basin are awareness creation to water users so that they come together to form water users associations (WUAs), encouraging water users to pay fees for water use by applying for water rights and emphasizing on formalization of informal institutions to minimize marginalization of women and reduce power struggles between formal and informal institutions. However, it is not known whether or not these efforts have contributed to improved livelihood and poverty alleviation.

Against this backdrop, the study sought to address the question: "What is the contribution of IWRM in poverty alleviation and improved livelihood?"

1.2 Objectives

The overall objective of this study was to investigate the links between implementation of IWRM and poverty reduction and improved livelihood. The specific objectives were to:

(i) Assess how IWRM has been implemented through community participation;
(ii) Find out how the implementation of IWRM has contributed to improvements in the livelihoods of the local communities;
(iii) Assess how the local people use their assets and capabilities in supporting livelihoods using water as a major input; and
(iv) Find out how the local people are capacitated in the implementation of IWRM for poverty alleviation.

1.3 Significance of the Study

The results of this study are expected to add more information towards a better understanding of implementation of IWRM for poverty alleviation and improved livelihood. The country has been implementing IWRM since the outset of regulatory framework reforms in 2000s. Hence, assessment of its contribution to poverty alleviation is important for the country's overall initiatives to improve the lives of the people.

Water resources play a significant role in poverty alleviation and the overall socio-economic development of a country. Proper water resources management in the Pangani River Basin (PRB) has the potential for improving livelihood of the basin community. The basin also offers several opportunities for national economic development due to existence of both large scale and small scale irrigation schemes and three hydropower stations contributing up to 17% of hydroelectricity in Tanzania.

1.4 Research Questions

i. What economic activities were people engaged in before IWRM was implemented?
ii. Is there a change in people's livelihood as a result of the implementation of IWRM?
iii. How are the local people involved in the implementation of IWRM?
iv. Has the implementation of IWRM contributed to improving the livelihood of the people?

1.5. Structure of the Report

The body of this report opens with Chapter One which presents the introductory section which constitutes of objectives of the study; problem statement; significance of the study and research questions. IWRM and poverty alleviation are presented in Chapter Two. In this chapter the Conceptual Framework is also presented. Chapter Three deals with the methodology of the study, followed by Chapter Four, which presents and discusses results. The last chapter concludes and provides recommendations based on the findings.

CHAPTER TWO: WATER RESOURCES MANAGEMENT AND POVERTY ALLEVIATION

2.1 Integrated Water Resources Management

IWRM has continuously been receiving attention since the International Conferences held in 1992 in Dublin on water and environmental issues, and then in Rio de Janeiro, Brazil. As Global Water Partnership (2000) noted, IWRM is seen as a promising approach in ensuring equitable and sustainable use of water resources.IWRM is a response to the interconnectedness of the water cycle at the catchment and aquifer scale, requiring that the full range of water users, their needs and impacts be considered together at both a policy and practice level in order to achieve equitable, efficient and sustainable water use (Lankford and Hepworth, 2010). Integrated water resources management helps to ensure continuous devotion, since issues of sustainable supply, sanitation, waste treatment, irrigation schemes, drainage and watershed conservation cannot be properly dealt with *ad hoc* measures (World Water Assessment Programme, 2009).

This argument concurs with Lankford and Hepworth (2010) who posit that integrated approach to water resources management should be a foundation to sustainable availability of water. Proper water resources management is also essential for sustainable development through ensuring availability of enough and good quality water, proper sanitary conditions, economic and industrial advancement and conservation of the environment (Lankford *et al.,* 2007).

IWRM perceives water governance as a multi-stakeholder process in which social, political, and economic institutions and their relationships are regarded as important for water development and management (Iza and Stein, 2009). According to Global Water Partnership (2000), IWRM is based on four guiding principles proposed in the Dublin Conference on Water and Environment (1992) as summarized here under:

i) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with the protection of natural ecosystems.
ii) Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels. This requires the effective engagement of all stakeholders in the decision-making process because water as a resource affects the lives and livelihood of everyone.
iii) Women play a central part in the provision, management and safeguarding of water. The principle recognises that in many societies, women have a much less influential role than men do when it comes to decision-making processes related to water management. Therefore, implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources management, including decision making.
iv) Water has an economic value in all its competing uses and should be recognised as an economic good. Here it is important to point out that whilst the value of water should be recognised to enable the rational allocation of water as a scarce resource, charging for water

means applying an economic instrument in order to influence people's behaviour towards conservation of water resources.

As the discourse on IWRM implies shifting from using water purely for economic development to incorporating community and environmental concerns to develop water use in a more equitable and sustainable way, water related policies are being reformed to reflect the new thinking (World Water Assessment Programme, 2009). The implementation of IWRM in most developing countries is through establishment of river basin authorities and enhanced participation of stakeholders (Pahl-Wostl *et al.,* 2007; World Water Assessment Programme, 2009).

There is a close link between IWRM implementation and poverty alleviation. The IWRM has tremendous potential to reduce poverty in rural communities by improving livelihoods through improving access to agricultural water and its use, reduced walking distances in accessing drinking water and proper stakeholders participation (IWMI, 2007). Not only can the successful implementation of IWRM prevent human health, economic and environmental losses that might impede development and frustrate poverty reduction efforts, but the participative processes comprising good IWRM can also help to achieve the MDGs.

Key features of the MDGs are the need to address poverty, gender equality and health issues, while also striving to attain environmental sustainability (Funke *et al*., 2007). High poverty-levels and food insecurity are important indicators that IWRM is not being implemented properly. In fact, poverty and unsustainable livelihoods often contribute to degradation of water sources, and planning needs to take more effective account of the multiple linkages between poverty and water resources management (FAO, 2006). However, regardless of the potential of IWRM in poverty alleviation, there is insufficient evidence of its impacts - either positive or negative - on poverty alleviation, particularly in the Pangani Basin.

2.2 Water Resources Management and Poverty Alleviation

Poverty is an important variable in the present study. This section briefly discusses the definitions and measurement of poverty. Definition of poverty differs from place to another and from one person to another. In this premise, when one asks ten people to define poverty, ten answers are likely to be obtained. The reason for this is that different criteria have been used or can be used to define poverty. This makes poverty contextual and bound to change in both space and time. Poverty can be defined as a state of lacking basic needs or socially acceptable money, or material possessions (Kanbur and Squire, 1999). However, the challenge to application of this definition is that it requires more information on how basic needs are defined and by who and what is socially acceptable money or material possessions. Despite this challenge, this definition of poverty is often adopted by economists and policy analysts who focus on money-metric measures of poverty, based on assumption that a person's or household's material standard of living largely determines their well being (Ceena and Falkingham, 2001). Another important aspect of this definition is that it is market based since it considers command over market purchased goods and services. To other scholars, poverty exists when a person falls short of economic welfare deemed to constitute a reasonable minimum (Lipton and Ravallion, 1995). Yet, others have defined poverty based on inability to meet basic nutritional needs (Ojha, 1970) while

others view poverty, as a function of education and/or health; life expectancy and child mortality (Singer, 1975).

Due to practical reasons, such as the case of measurement and availability of data the most commonly used definition of poverty is based on incomes. A person is classified as poor if his or her income level falls below some minimum level necessary to meet basic needs like food, shelter and clothing. It should be noted here that what is minimum to satisfy basic needs varies across societies. This minimum level is usually called the poverty line. In this context, a person is considered poor if he or she falls below that line. Poverty lines are not universal as different countries use lines which are appropriate to their level of development, societal norms and values. Tanzania for example has the two poverty lines which were updated for price inflation between 2001 and 2007 to assess poverty levels in 2007. According to these poverty lines, a person is considered poor if he/she does not consume a minimum of 2,200 calories per day that are considered a minimum necessary for survival. Likewise the food basic line stands at Tshs. 10,219 while the basic needs poverty line which includes an additional allowance for non-food essentials stands at Tshs. 13,998 equivalent to about 7USD and 9USD respectively (National Bureau of Statistics, 2009).

In 1990 the World Bank introduced a commonly used poverty line known as dollar-a-day measure. This measure which is also based on household expenditure was intended to monitor progress in reducing poverty worldwide. This poverty line is expressed in the 1985 Purchasing Power Parity (PPP) and refers to household expenditure per household. The measure has been criticized especially in developing countries as it has many shortcomings. The most important limitation to this definition is that the measure does not allow for cost-of-transient and chronic poverty (World Bank, 1990) and it only values goods and services delivered through the market. It therefore presents a challenge to developing countries where most people obtain their goods including foodstuffs from farms (van de Walle and Nead, 1994). In addition, the line does not consider intra-household allocation of expenditure (Haddad and Kanbur, 1990) and does not sufficiently deal with differences in household size and composition (Lanjouw and Ravallion, 1995).

The broad definition of poverty does not only focus on command over market-purchased goods and services but includes other dimensions of living standards such as longevity, literacy, healthiness, powerlessness and lack of voice (Kanbur and Squire, 1999). The United Nations Development Programme in its 1997 Human Development Report sees poverty as denial of opportunities and choices that are most basic to human development to lead a long, healthy, creative life and enjoying a decent standard of living, freedom, self-respect and the respect of others (UNDP, 1997:15). In 2001, the UN provided a much broader definition of poverty:

> ..a human condition characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights (UN, 2001).

At its World Summit on Social Development in 1995, the UN Copenhagen Declaration described poverty as a condition characterized by severe deprivation of basic human needs including food, safe water, sanitation facilities, health, shelter, education and information (United Nations, 1995). Based on the broad definitions provided by the UN, a child can be considered poor if he or she cannot go to school and people considered poor if they cannot access health facilities regardless of income levels. This means that another way of understanding poverty is to ask individuals to define poverty and get an idea of what represents poverty in their context. The South African Participatory Poverty Assessment Survey found that poverty definitions given by the poor differ from those given by the non-poor (May, 2000). The non-poor see poverty as a lack of income while the poor associate poverty with (i) isolation from the community; (ii) lack of security; (iii) low wages (iv); lack of employment opportunities; (v) poor nutrition; (vi) poor access to service; (vii) poor education opportunities; and (vii) misuse of resources. In Tanzania, respondents in the 2002/3 Tanzania Participatory Survey described poverty as " a situation in which households are placed below a socially defined minimum level of well being, usually manifested in hunger, sickness, powerlessness and illiteracy (URT, 2002). In a similar survey in Uganda, poverty was defined in both material and non-material forms and viewed as 'complex, multidimensional, cyclical, seasonal and context-specific problems' (May, 2000: 26).

It is clear from the above definitions and criteria that because poverty affects many aspects of the human condition, including physical and psychological, a concise and universally accepted definition of poverty is elusive (Nader, 1994). In this premise, it is deemed important to indicate the definition that is particularly relevant to the study. The present study adopts the poverty definitions put forward by the UN. The choice of this definition is based on the fact that it covers basic human needs such as food, safe water and sanitation facilities. Others include health, shelter and education. Another reason the present study adopted the UN definition as opposed to income based definitions is that respondents are from rural areas where income opportunities are limited and most of them meet their needs from farms.

There is a close and direct link between water and poverty. Harmansen and Simensen (2002:1) in their study in Pangani Basin found that effective water resources management is a key factor and a necessary requirement for sustainable economic growth. Mwamfupe (2002) noted that households in the Pangani Basin were faced with problems in agricultural production due to poor availability of irrigated water. As a result, people have been increasingly engaged in non-farm activities. Growing non-agricultural activities can contribute to destruction of water resources due to the fact that such activities include brick making and charcoal making. Despite shortage of irrigation water, agriculture remains one of the major economic activities in the Basin (Ngana, 2001).

IWRM has been adopted over the last decade as the endorsed discourse on water resources management (Dungumaro, 2006). However, the extent to which IWRM can contribute to improved livelihood and poverty alleviation depends on various factors which can undermine it. Water resources management in the Pangani Basin has been found to be under pressure from such factors as increased population (and high population growth) and the need to fight against poverty (Tagseth, 2002). These factors are the causes of water conflicts in the area as people compete for resources to meet their needs. Other factors that may hamper IWRM for poverty

alleviation include changes in the consumption patterns due to technological changes and increased demand for hydropower plant.

Equity in utilization of water in the Basin is another potential factor undermining effective management of water resources. Mwaruvanda (2001) proposed eight factors to improve the situation. These include integrated approach and stakeholder participation among others.

2.3 The Conceptual Framework

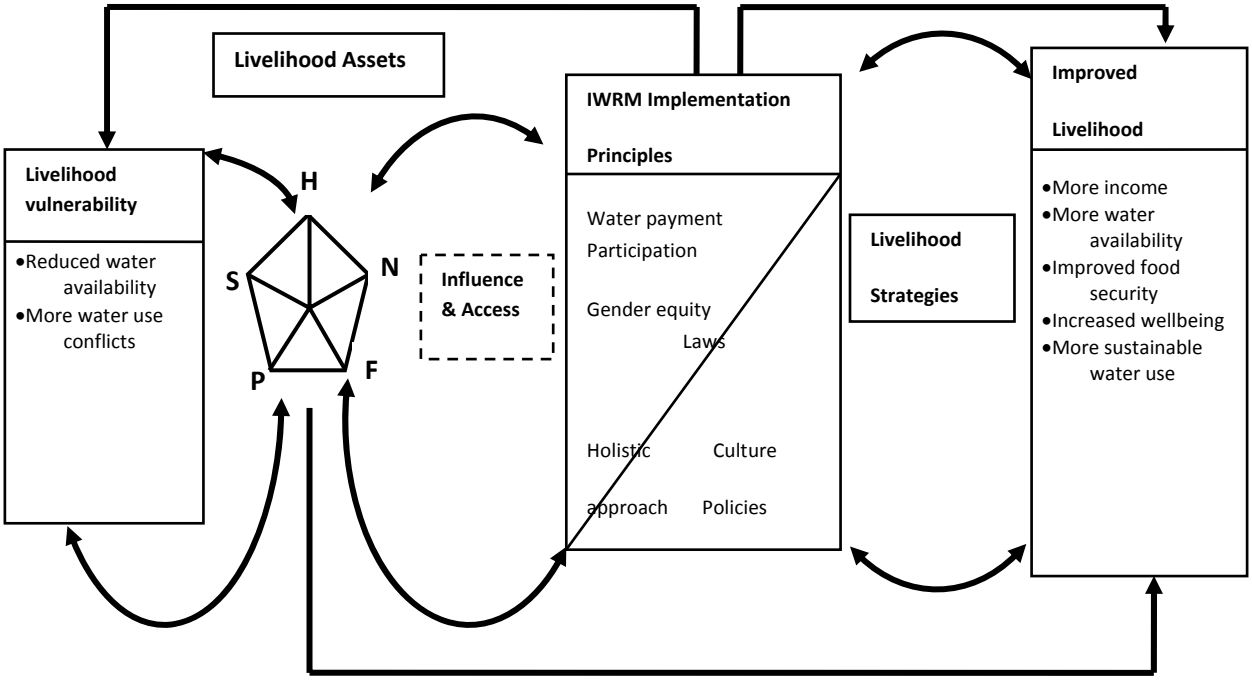
The analytical framework for this study is the Sustainable Livelihoods Framework (SLF) adopted from the UK Department for International Development (DFID) (Figure 2.1). According to Chambers and Conway (1992), a livelihood comprises the capabilities, assets (including both material and social resources) and activities required to make a living. A livelihood is sustainable when it copes and recovers from stresses and shocks, and maintains or enhances its capabilities and assets both now and in the future, while not undermining the resource base (*ibid*). Assets, also known as capital, are the key elements on which livelihoods are built and are divided into five core categories of capital. These are: human capital, natural capital, financial capital, social capital and physical capital.

The basis of SLF is the assets pentagon and the flexible combinations of – and trade-offs - between different assets such as human, physical, financial, social and natural ones. According to the SLF approach, the asset status of the poor is fundamental to understanding the options open to them and the strategies they adopt to improve their livelihoods. Thus, poor people can capitalize on livelihood assets to change from livelihood [2]vulnerability context to improved context. However, IWRM implementation can result to either improved livelihoods or livelihood vulnerability. In this premise, the principles and processes of IWRM have implication on livelihood strategies of local people.

[2] Vulnerability context refers to the shocks, trends and seasonality that affect people's livelihoods (often, but not always negatively) (DFID, 2001).

Figure 2.1: Conceptual framework adopted from the Sustainable Livelihoods Framework

Source: DFID (2001).



Key:

H = Human capital S = Social capital Natural capital P = Physical capital F = Financial capital

CHAPTER THREE: METHODOLOGY

3.1 The Study Area

The study area is the Pangani River Basin.. The basin extends from the northern highlands to the north-eastern coast of the country and lies between latitude 03º 05' 00" and 06º 06' 00" South and longitude 36º 45' 36" and 39º 36' 00" East. It covers an area of about 43,650 km^2 of which 5% lies in Kenya within the district of Taita – Taveta (IUCN, 2003). The basin is intersected by sixteen districts (Arusha Urban, Arumeru, Siha, Hai, Rombo, Moshi rural and urban, Mwanga, Same, Simanjiro, Kiteto, Lushoto, Korogwe, Kilindi, Handeni, Muheza and Pangani) within Kilimanjaro, Manyara, Arusha and Tanga regions. The Pangani River drains from the slopes of Mount Kilimanjaro, Mount Meru, the Pare and Usambara Mountains and extends 450 kilometres to its outlet in the Indian Ocean (PBWO/IUCN, 2007). The Pangani River is divided into five sub-catchments, namely; Kikulatwa, Ruvu, Mkomazi, Pangani mainstem and Luengera (PBWO/IUCN, 2006).

Climatically, the rainfall patterns are largely influenced by altitude with the highland areas and coastal lowland areas receiving the highest rainfall. Generally, most parts of the highlands receive mean annual rainfall up to 3000 mm, while most parts of the lowlands receive less than 500 mm. The basin has a bimodal pattern of rainfall with long rains between March and June and short rains in November and December. Temperatures are influenced by altitude. Lower temperatures are found in the highlands and higher temperatures in the lowlands. The basin is one of the highly populated areas in Tanzania, posing serious challenges to water resources management. In 2002, the basin was estimated to have 3.9 million people (URT, 2003).

More than 80 per cent of the population in the basin depends on agriculture to support livelihood (Mwamfupe, 2002). Important to the present study is the fact that the basin supports a number of economically important activities including sugar plantations and three hydropower plants. Furthermore, agriculture schemes in most parts of the basin are carried out through irrigation, making water a vital resource for not only livelihood but also poverty alleviation. Other economic activities such as livestock keeping are also done in the basin, especially by the *Maasai* pastoralists.

The reasons for the selection of the PRB as the study area are as follows:

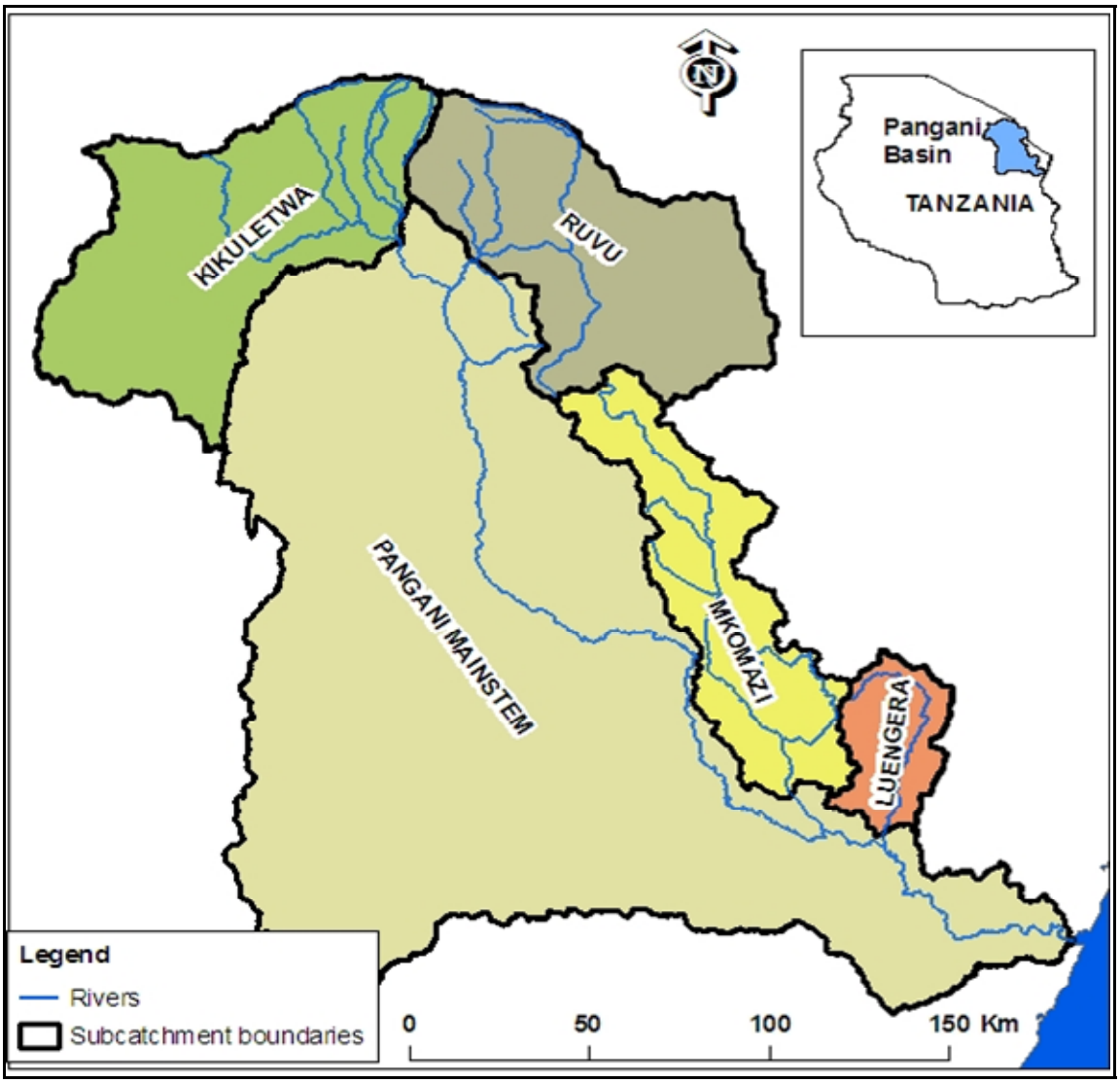
(i) Water is a vital resource for most economic and livelihood supporting activities in the area; and
(ii) The basin is well known for advancement in IWRM implementation in the country.

3.2 Sampling Techniques

This study employed a purposive sampling procedure. The sample was drawn in areas where IWRM is being implemented. The PRB is a basin with more evidence of IWRM implementation

compared to the other eight basins[3]. The PRB was delineated into five sub-catchments, namely: Kikuletwa, Ruvu, Mkomazi, Pangani mainstem and Luengera (Map 3.1). Each of these sub-catchments was represented in the study. Initially the plan was to select two villages (one in the highlands and the other in the lowlands) in each of the five sub-catchments making a total of 10 villages. However, after gaining awareness of the social and organizational settings of the study area, only six villages were selected (2 from Kikuletwa sub-catchment and 1 each from Ruvu, Mkomazi, Luengera and Pangani mainstem sub-catchments). The selected study villages include Rundugai and Kikafu chini from Kikuletwa sub-catchment, Kigonigoni from Ruvu sub-catchment, Maore from Mkomazi sub-catchment, Kirya from Pangani mainstem sub-catchment and Chekelei from Luengera sub-catchment.However, the villages were reduced to six after reconnaissance survey due to the reasons given under data collection methods (section 3.3). From each village, a sample size of 50 households was selected for questionnaire administration.

[3] Other basins are Wami Basin; Rufiji Basin; Ruvu and S. Coat Basin; Lake Nyasa Basin; Internal Drainage Basin of Lake Eyasi; Manyara and Bubbu depression; Lake Rukwa Basin; Lake Tanganyika Basin; Lake Vistoria Basin



Map 3.1: PRB's Five Sub-Catchments

3.3 Data Collection Methods

A combination of qualitative and quantitative methods of social research was used to obtain the data. Quantitative data was collected using a questionnaire, while personal observations formed the tools for qualitative data collection. As a familiarization exercise, the researchers visited all the five sub-catchments of the Pangani Basin. This went hand in hand with the selection of case study villages.

Participatory wealth ranking was conducted in all the six villages. In each village, researchers collaborated with the community in conducting the wealth ranking exercise. Three socio-economic strata used in the wealth ranking exercise were low income, middle income and high income. The village household registry was used in determining the household wealth status. Each household was written on a card and participants were asked to place each card in

respective wealth category. The criteria used to place the households in different wealth categories are summarized in Table 3.1.

Table 3.1: Participatory wealth ranking criteria in selected case study villages

Case study villages	Socio-economic strata		
	Low income	**Middle income**	**High income**
Rundugai	Has no irrigated farm; house made up of earth bricks with grass thatched roof; some have no houses; sell their labour for cash; has hens and <5 heads of cattle; experience food shortage for more than 5 months per year; educate children to primary school level.	Has <2 ha; irrigated farm; house made up of earth bricks with corrugated iron roof; owns shop/kiosk/or tea/food room; owns bicycle; has a stereo cassette player; bed with mattress; has cattle (>5 <20 heads); experiences food shortage for at least 1 month per year; educates children to secondary school level.	Has 2 ha and above irrigated farm; power to rent farm in irrigation area; house made up of burnt bricks, floor finished with cement and with corrugated iron roof; tractor/power tiller and/or milling machine; owns shop/kiosk/or tea room; bicycle and/or motorcycle/car; has a stereo cassette player and/or TV set; sofa set, bed with mattress; has dairy cattle and other livestock more than 20 heads; never experiences food shortage; educates children to secondary school level and above.
Kikafu chini	Has no irrigated farm; house made up of wood with grass thatched roof; some have no houses; sell their labour for cash; have few hens; educate children to primary school level.	Irrigated land at least 1.5 ha; motorcycle or bicycle; produces enough food for the whole year; can take children to school; has cash crops (paddy, vegetables, beans); owns few heads of cattle, applies fertilizers on his/her farm plot.	Owns irrigated farm up to 5 ha; has power/money to rent irrigated farms; house made of burnt bricks, floor finished with cement and with corrugated iron roof; tractor/power tiller; owns shop/kiosk/or tea/food room; owns bicycle and/or motorcycle; stereo cassette player and/or TV set; has sofa set, bed with mattress; has many heads of cattle.
Kigonigoni	Has no irrigated farm; house made up of wood with grass thatched roof; sells labour for cash or food; has few hens; experiences food shortage for more than 8 months per year.	Has irrigated land < 1ha; modest house; can produce food for at least 6 months; borrowed cattle for production of milk and manure; can take children to school.	Irrigated land at least 1.5 ha; motorcycle or bicycle, can hire irrigated land, produces enough food for the whole year, can take children to school; has live stock, applies fertilizers on his/her farm plot.
Kirya	Has no irrigated farm; house made of wood with grass thatched roof; sells labour for cash or food; has hens and few heads of cattle.	Irrigated land at least 1.5 ha; motorcycle or bicycle; produces enough food for the whole year; can take children to school; has	Irrigated land > 2.5 ha; owns a car or tractor or milling machine; modern house with corrugated iron sheets roof; kiosk; gets remittance from son(s) or daughter(s); applies

		modest livestock. modest house and house possessions; applies fertilizers on his/her farm plot.	industrial fertilizers on his/her farm plot.
Maore	Productive land <1 ha; cannot produce enough food for 6 months; grass thatched house; mainly works as a casual labourer and sells natural resource products e.g. wild fruits and charcoal.	Irrigated land at least 1.5 ha; motorcycle or bicycle; produces enough food for the whole year; can take children to school; has cash crops (ginger, tomatoes); owns livestock; applies fertilizers on his/her farm plot.	Irrigated land > 2.5 ha; owns a car or tractor or milling machine; modern house roofed with corrugated iron sheets;, has a kiosk; gets remittance from son(s) or daughter(s); applies industrial fertilizers on his/her farm plot.
Chekelei	Has no irrigated farm; house made of earth bricks with grass thatched roof; sell their labour for cash or food; has few hens; experience food shortage for more than 6 months a year.	Has irrigated land < 1ha; modest house; can produce food for at least 6 months; borrowed cattle for production of milk and manure; can take children to school.	Irrigated land at least 1.5 ha; motorcycle or bicycle; produces enough food for the whole year; can take children to school; has livestock; applies fertilizers on his/her farm plot.

Source: Survey Data, 2010

Based on the above mentioned criterion, sample households were selected as presented in Table 3.2.

Table 3.2: Sample size by wealth category

Village	Sample size			Total
	Low income	Middle income	High income	
Rundugai	10	27	13	**50**
Kikafu chini	15	29	6	**50**
Kigonigoni	18	22	10	**50**
Kirya	20	25	5	**50**
Maore	15	25	10	**50**
Chekelei	25	17	8	**50**
Sub-total	**103**	**145**	**52**	**300**

Source: Survey Data, 2010

3.4 Data Processing and Analysis

The Statistical Package for Social Scientists (SPSS) was used for data entry, cleaning and analysis. Descriptive analysis was mainly used for analysing data collected through a structured questionnaire. Inferential analysis was also used in order to offer an indepth analysis for improving the interpretation of the relationships between variables.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Characteristics of Respondents

This chapter presents and discusses the study findings. It would be noted that to a large extent, analysis is done through wealth categories. The reason behind this analysis is that the focus of the study is on poverty alleviation and improved livelihood through implementation of the IWRM. Analysis through wealth category, therefore, offers a way of linking wealth and observed results.

The results of this study indicate that out of 300 respondents 24% were women (Table 4.1) with significant difference between wealth class (Chi square = 16.290, $P < 0.001$). The low wealth class had the highest proportion of women respondents (31%) while the high wealth class had the lowest proportion of women respondents (13%). Since respondents were drawn from female heads, results suggest that female headed households are poorer than their male counterparts. Poverty in female headed households in the study area is not an isolated case. Literature maintains that women make up a disproportionate number of the poor. The United Nations found that of the world's poor, 60-70 percent is women (UNDP, 1995; UN, 1996). Kimenyi and Mbaku (1995) assert that there exists a strong relationship between female headed households and the incidence of poverty. Dungumaro (2009) notes that female headed households are generally poorer than male headed ones. There are several reasons behind feminization of poverty. They include disparities in rights, entitlements and feminization of labour (Chant, 2003).

Table 4.1: Sex of the respondent by wealth category

Sex	**Wealth class**	**Village**						**Mean**
		Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Male	Low	70	66	57	70	78	76	**70**
	Medium	71	70	74	80	76	65	**73**
	High	91	81	92	84	87	88	**87**
Mean		**77**	**72**	**74**	**78**	**80**	**76**	**76**
Female	Low	30	34	43	30	22	24	**31**
	Medium	29	30	26	20	24	35	**27**
	High	9	19	8	16	13	12	**13**
Mean		**23**	**28**	**26**	**22**	**20**	**24**	**24**

Source: Survey Data, 2010

The average age of respondents was 47.8 years, with little variation between wealth classes (Table 4.2). However, Kogonigoni, Maore and Chekelei villages had relatively older respondents at 50, 49.5 and 48.3 years on average, respectively, compared to 45.1, 46.8 and 47.3 years for Kikafu chini, Kirya and Rundugai, respectively.

Table 4.2: Age of respondents in years

Wealth class	**Village**						**Wealth-class mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Low	45.2	38.9	49.3	43.1	46.5	47.0	**45.0**
Medium	50.7	48.3	48.7	49.0	48.1	49.6	**49.1**

High	46.1	48.2	51.8	48.2	53.9	48.2	**49.4**
Village mean	**47.3**	**45.1**	**50.0**	**46.8**	**49.5**	**48.3**	**47.8**

Source: Survey Data, 2010.

Table 4.3 shows that the average household size for the entire sample was 5.8 persons. The number of household members is one of the basic demographic characteristics of a household. However, identifying them may not be an easy task. The complexity arises from the methods of enumeration. Usually there are two methods of enumeration: *de facto* and *de jure*. In *de facto* a person has to be presented in the specified place during the time of the survey for him/her to be enumerated. In *de jure*, a person is enumerated regardless of their presence during the time of the survey (Kpedepko, 1982). Both methods have their advantages and disadvantages. Decision to employ a particular method primarily depends on the purpose of the survey. The present study employed *de jure* since it makes more sense to know the number of people who "usually" reside in a household than the number of people are physically present at the time of the survey.

A comparison of villages shows that Rundugai had the largest mean household size (6.2) followed by Kikafu chini and Chekelei with average household size of 5.9 each, Maore (5.8), Kirya (5.7) and Kigonigoni (5.5). Household sizes for the study villages are not in comparison with that of the country recorded during the last census conducted in 2002. The recorded size was 5.1 persons for rural areas while that for urban areas was 4.8 (URT, 2003). The household size for the study areas is higher even than the recorder values during the 1988 census. This suggests an increase in the population in the study area. This observation coincides with that of Ngana (2002) who observed an increase in population in the basin. The increase in number of people translates into increased demand for water for various uses notably domestic and agriculture.

Table 4.3: Average household size

Wealth class	**Village**						**Wealth-class mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Low	5.9	7.3	5.7	5.7	6.1	6.5	**6.2**
Medium	6.8	5.6	5.4	5.8	5.4	5.9	**5.8**
High	6.0	4.8	5.4	5.8	5.9	5.1	**5.4**
Village mean	**6.2**	**5.9**	**5.5**	**5.7**	**5.8**	**5.9**	**5.8**

Source: Survey Data, 2010

Using paired sample T Test, the differences in household size between wealth classes of 6.2, 5.8 and 5.4 on average for low, middle and high class, respectively, were significant ($P < 0.001$). This observation presents practical challenges because household with more members has higher probability of experiencing poverty than those with fewer members (Kimenyi and Mbaku, 1995).

Education level

Table 4.4 indicates that the majority of the respondents had primary education (78%); the remaining 10% had secondary education, 8% had no formal education, while 2% had adult education and post-secondary education, respectively. The middle wealth category had the highest proportion of respondents who had primary education (82%) while high wealth category had the highest proportion of respondents who had secondary education (18%) and post-secondary education (5%). On the other hand, the proportion of respondents who had no formal education and adult education was higher in the low wealth category compared to other categories.

In general, there is significant positive correlation between wealth class and level of education with correlation coefficient of 0.2 at 0.01 significant levels. This indicates that the level of education is higher for wealthier households compared to the poorer wealth category.

Table 4.4: Education level of household head by village and wealth category (%)

Education level	**Wealth class**	**Village**						**Mean**
		Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
No formal education	Low	20	0	11	25	13	4	12
	Medium	4	0	5	8	4	24	8
	High	0	17	0	0	0	0	3
Mean		**8**	**6**	**5**	**11**	**6**	**9**	**8**
Adult education	Low	10	0	6	0	7	8	5
	Medium	0	0	5	0	4	0	2
	High	0	0	0	0	0	0	0
Mean		**3**	**0**	**4**	**0**	**4**	**3**	**2**
Primary education	Low	70	80	78	75	80	84	78
	Medium	89	72	86	92	80	71	82
	High	69	50	90	80	80	75	74
Mean		**76**	**67**	**85**	**82**	**80**	**77**	**78**
Secondary education	Low	0	20	6	0	0	4	5
	Medium	7	24	5	0	12	0	8
	High	23	33	10	20	10	13	18
Mean		**10**	**26**	**7**	**7**	**7**	**6**	**10**
Post-secondary education	Low	0	0	0	0	0	0	0
	Medium	0	3	0	0	0	6	2
	High	8	0	0	0	10	13	5
Mean		**3**	**1**	**0**	**0**	**3**	**6**	**2**

Source: Survey Data, 2010

Kirya had the highest proportion of respondents with no formal education (11%) followed by Chekelei (9%), Rundugai (8%), Kikafu chini and Maore with 6% each and Kigonigoni (5%). With regard to formal education, the majority of respondents in all villages had primary education although the proportion of respondents with primary education was relatively low in Kikafu chini. Increasingly, Kikafu chini had the highest proportion of respondents who had

secondary education, while Chekelei, Maore and Rundugai were leading in terms of proportion of respondents who had post-secondary education.

Household main economic activity

The main economic activities were farming, petty business and others such as livestock keeping, shop keeping and casual labouring. Table 4.5 shows that the main economic activity for the majority of respondents was farming (96%). All respondents in Rundugai, Kigonigoni and Kirya villages relied on farming as their main economic activity. Farming was also the main economic activity for 95%, 90% and 88% of the respondents in Kikafu chini, Chekelei and Maore, respectively.

Table 4.5: Percent distribution of main economic activities by wealth status

Economic activity	**Wealth class**	**Village**						**Mean**
		Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Farming	Low	100	86	100	100	79	76	90
	Medium	100	100	100	100	96	94	98
	High	100	100	100	100	90	100	98
Mean		**100**	**95**	**100**	**100**	**88**	**90**	**96**
Petty business	Low	0	7	0	0	0	4	2
	Medium	0	0	0	0	4	0	1
	High	0	0	0	0	10	0	2
Mean		**0**	**2.5**	**0**	**0**	**5**	**1**	**1**
Others	Low	0	7	0	0	21	20	8
	Medium	0	0	0	0	0	6	1
	High	0	0	0	0	0	0	0
Mean		**0**	**2.5**	**0**	**0**	**7**	**9**	**3**

Source: Survey Data, 2010

Comparison by wealth category shows that the majority of respondents in middle and high wealth group (98%) relied on farming as their main economic activity and only two percent relied on petty business. On the other hand, farming was the main economic activity for 90% of the respondents in low wealth category, while 8% relied on other activities such as casual labouring and livestock keeping, and the remaining two percent relied on petty business - mainly sale of forest products. These results are in line with Mwamfupe (2002) who found that despite inadequate supply of irrigated water in the Pangani basin, agriculture remains the main economic activity. Furthermore, this observation suggests that there is need for proper water resources management to ensure sustainable supply for agricultural purposes.

Estimated annual household income

Respondents were asked to estimate their annual income as summarized in Table 4.6. The average annual income in all villages were Tshs. 3,482,174/=. Maore had the highest mean annual income (Tshs. 4.5 million), followed by Kirya (Tshs. 3.9 million), Kikafu chini (Tshs. 3.8 million), Rundugai (Tshs. 3.5 million), and Kigonigoni (Tshs. 3.4 million). The village with the lowest mean annual income was Chekelei (Tshs. 1.6 million).

Results indicate a remarkable variation between wealth categories. The average annual income for the low wealth group was Tshs. 984,698/=, while the middle wealth category had an average annual income of Tshs. 2,361,872/=. The mean annual income for the high wealth category was Tshs. 7,099,951/=. Using paired sample T-Test, the difference in annual income between low, medium and high wealth categories was highly significant (T = 10.56, P < 001).

Table 4.6: Average annual income in Tanzanian Shillings (estimated)

Wealth class	Mean annual income per village (estimated) in Tanzania Shillings						Wealth-class mean
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Low	895,000	586,000	697,857	1,298,350	1,733,778	697,200	**984,698**
Medium	3,119,250	2,175,862	1,818,462	3,136,000	2,470,895	1,450,765	**2,361,872**
High	6,179,208	8,750,000	7,900,000	7,360,000	9,548,000	2,862,500	**7,099,951**
Village mean	**3,597,819**	**3,837,287**	**3,472,106**	**3,931,450**	**4,584,224**	**1,670,155**	**3,482,174**

Source: Survey Data, 2010

4.2 IWRM Implementation and Community Participation

The majority of the respondents (92%) revealed that implementation of IWRM in the PRB started in 1990s and only 8% of the respondents said that implementation of IWRM started earlier than 1990. All respondents in Kikafu chini, Kirya, Kigonigoni, and Maore, and 88% and 62% of respondents in Rundugai and Chekelei, respectively, reported that implementation of IWRM started in 1990s. The remaining 12% and 38% of the respondents from Maore and Chekelei villages believed that IWRM implementation began in 1970s and 1980s.

The perception by a majority of the respondents that IWRM implementation started after 1990s correspond well with the establishment of the Pangani Basin Water Office and Board in 1991 and 1992, respectively. This is because the formal implementation of IWRM could not have been possible in the absence of the Basin Water Office and Board.

However, indication of some respondents who believed that IWRM implementation started before formation of Basin Water Office (1991) means that IWRM had been implemented informally in the study area. Since community participation and holistic approach are among the indicators of IWRM implementation, there is evidence that through customary arrangements, water users in the PRB had been using the ecosystem approach in managing water and associated vegetation holistically since time immemorial (Msuya, 2010; Notter, 2010).

4.2.1 Indicators of IWRM Implementation

Formation and joining water user groups/associations, water use payment system, improvement of traditional furrows, women participation in irrigation water management and managing water and allied resources holistically were indicators for IWRM implementation reported in the study area. The first three indicators were reported by a relatively large proportion of the respondents and the remaining two were reported by few respondents (Table 4.7). A village wise comparison shows that formation and joining water user groups/associations, water use payment system,

improvement of traditional furrows were reported by a relatively large proportion in almost all villages.

However, relatively few respondents (18%) reported water payment system in Kigonigoni village while in Maore village very few respondents (4%) reported improvement of traditional furrows. On the other hand, women participation in irrigation water management was reported by generally few respondents in all study villages except Kirya while in Rundugai, Kirya and Chekelei the respondents did not report holistic management of water and its allied resources.

Table 4.7: Response on the indicators of IWRM implementation

Indicators for IWRM implementation	**Response per village (%)**						**Mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Formation of water user groups/associations	32	30	28	24	30	24	**28**
Payment for (irrigation) water use	42	38	18	34	46	28	**34**
Improvement of traditional furrows	20	26	36	38	4	44	**28**
Women participation in irrigation water management	6	4	4	0	6	4	**4**
Managing water resources holistically	0	2	2	0	2	0	**1**
Do not know	0	0	12	4	12	0	**5**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey Data, 2010

Respondents were asked to provide information on their participation in the implementation of IWRM as summarized in Table 4.8. Results indicate that communities participate in IWRM implementation either through joining water user groups/associations, paying water use fees, conservation of water catching areas or participating in environmental education campaign. The majority of the respondents participate in the implementation of IWRM through joining water user groups/associations (71%) followed by water user fees' payment (58%), environmental education campaign (31%), and few participate through conservation of water catchments (19%).

Table 4.8: Multiple response on community participation in IWRM implementation

Community participation in IWRM implementation	**Frequency (N=300)**	**Percentage**
Joining water user groups/associations,	213	71
Water user fees payment	174	58
Environmental education campaign	93	31
Conservation of water catching areas (water catchments)	57	19
Mean	**140**	**47**

Source: Survey Data, 2010

Further, the results reveal three categories of water user entities in which the respondents have joined. These include irrigators' associations registered as cooperative societies, water user associations (WUAs) and unregistered water user groups. While irrigators' associations (cooperative societies) were mainly reported in Kikafu chini and Chekelei villages, WUAs were reported in Rundugai and Maore villages and water user groups were reported in Kirya and Kigonigoni villages. Kikafu chini irrigators' association and Chekelei irrigators' association are irrigators' associations in which the respondents from Kikafu chini and Chekelei villages have joined while the respondents from Rundugai and Maore villages have joined Tegemeo and *MUWAHI*[4] WUAs respectively. In Kigonigoni village, the respondents were reported to join two water groups, namely *Kirurumo* water users' group and *Kwakihindi* water users' group.

Formation of these water user entities was facilitated either by NGOs, the Pangani Basin Water Office (PBWO) or the Kilimanjaro Zonal Irrigation and Technical Support Unit (KZITU). Out of 300 respondents, 47% said the formation of irrigators associations, WUAs and water user groups was facilitated by NGOs, 25% reported the PBWO as the facilitator for the formation of the mentioned water user entities, 22% believed that formation of water user entities was facilitated by KZITU while 6% did not know the organizations facilitated the formation of the three categories of water user entities.

Village wise analysis revealed 74% of the respondents from Kirya, 66% from Rundugai and Maore and 86% from Kigonigoni who were of the opinion that formation of different water user entities was facilitated by NGOs including the World Vision Tanzania, PAMOJA Trust, Traditional Irrigation and Environmental Improvement Organisation (TIP) and Mixed Farming Improvement Programme (MIFIPRO) Trust. On the other hand, 60% and 62% of the respondents said formation of water user entities was facilitated by KZITU while the PBWO's facilitation for formation of different water user entities was reported by relatively few respondents: 22% from Kirya, 4% from Rundugai, 36% from Chekelei, 26% from Kikafu chini, 12% from Maore and 10% from Kigonigoni village.

4.2.2 IWRM Implementation and Water Payment

The majority of the respondents (85%) were paying charges/fees for water use, and only a small proportion (15%) did not pay any charges/fees. Those who paid water use fees/charges reported that they were paying for either irrigation water use (63%) or domestic water use (17%) or both (30%).

In Tanzania domestic water is paid for in areas where there is tap water service. Out of six villages, only two (Rundugai and Maore) had tap water service, meaning that payment for domestic water use was done in these villages only. Payment for domestic water was done on monthly basis and the mean payment was Tshs. 4,205. Comparison between wealth categories shows that high income class (high wealth category) was paying large amounts of money for

[4] MUWAHI is a short form for *Muungano wa Wakulima Watumia Maji Hingilili Tambarare (Hingilili* water users' association*)*

domestic water use on average and the low income (wealth) categories was paying relatively small amounts of money for domestic water use on average in both villages.

The mean amount of money paid for domestic water use by low income category was Tshs. 1,730 and Tshs. 3000 compared to the amount paid by the middle income category of Tshs. 4,500 and Tshs. 4,800 and high income category of Tshs. 4,600 and Tshs. 6,600 for Maore and Rundugai villages, respectively (Fig. 4.1).

Before IWRM implementation, the average distance to get water for domestic use was 2.4 kilometers (km) but the variation between villages was high ranging from 0.3 km to 4.4 km. Respondents at Kirya and Kigonigoni villages had to walk the longest distance on average (4.4 km and 3.5 km respectively) to get domestic water compared to respondents from Chekelei (1.7 km), Rundugai (1.5 km), Kikafu chini (1.0 km) and Maore (0.3 km). The onset of IWRM has reduced the mean distance to sources of domestic water from 2.4 km to 1.3 km. Comparison of villages shows that respondents in Kirya had to walk the longest distance on average (4.2 km) followed by Chekelei (1.7 km). In the rest of study villages, respondents indicated that they walked a distance of less 1 km. In Maore the distance had not changed, at Rundugai, Kikafu chini and Kigonigoni villages the distance to sources of domestic water has been shortened to 0.5 km, 0.6 km and 0.7 km, respectively.

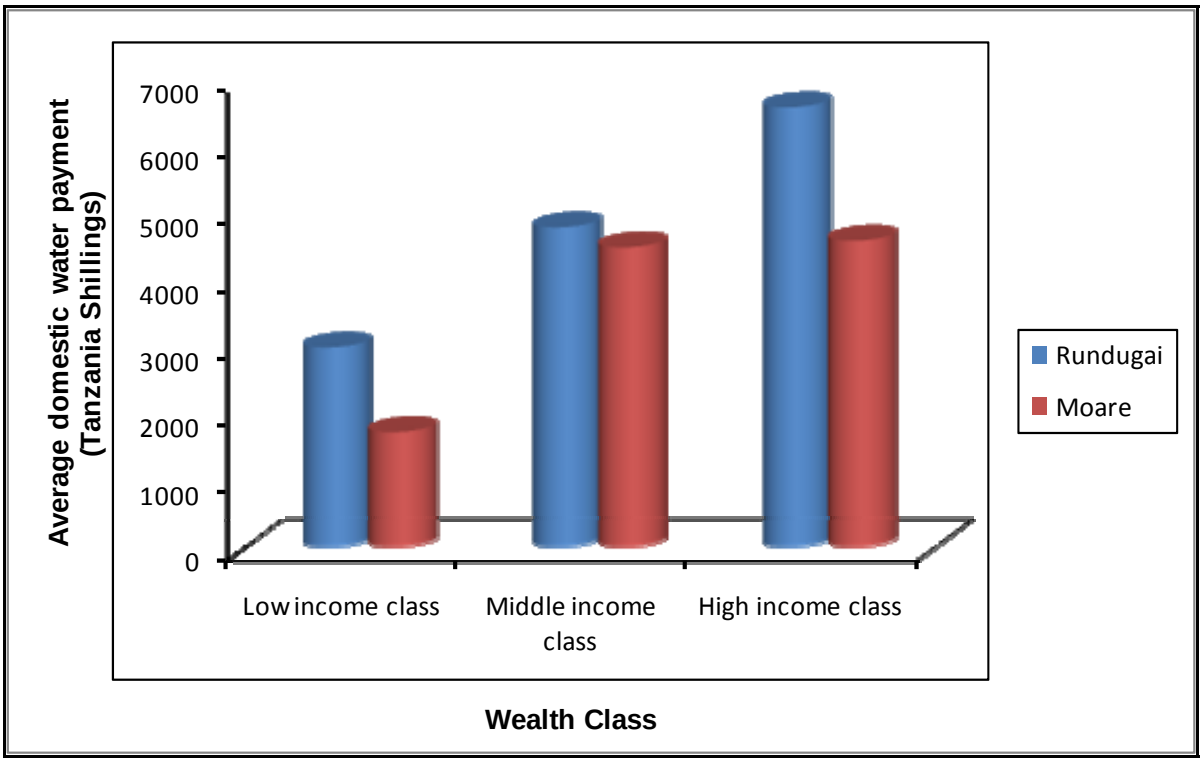


Figure 4.1: Average payment of money for domestic water use by wealth class per month
Source: Survey Data, 2010

Unlike domestic water which was only paid for in two villages, payment for irrigation water use was done in all villages, except Chekelei. Notwithstanding the effort by KZITU of developing irrigation scheme, facilitating the formation of irrigators' association, and formalization of irrigation water payment by the PBWO through water rights, Chekelei farmers were not paying for irrigation water use. The reason behind non-payment was the irrigation infrastructure which has made the situation worse. A plausible explanation to this could be increased competition for irrigation water or inequity utilization.

The frequency of paying for irrigation water use was twice per annum and the mean amount of money paid as irrigation water fee was Tshs. 6,864 per year ranging from 1000 – Tshs. 80,000. The amount of money paid for irrigation water use differed significantly between wealth class ($T = 10.052$, $P < 0,001$). On average, the high wealth group paid the highest amount of money as irrigation water charge/fee (Tshs. 10,216) while the middle wealth class paid Tshs. 6,409 and the low wealth class paid Tshs. 3,966 as irrigation water charges (Table 4.9).

Comparison of villages shows that Kikafu chini farmers paid the highest amount for irrigation water use on average (Tshs. 18,616), followed by Maore (Tshs. 7,387), Rundugai (Tshs. 6,993) and Kirya (Tshs. 6,648) while Kigonigoni paid the lowest amount (Table 4.9).

Table 4.9: Average money paid for irrigation water use per year

Wealth class	**Mean payment per village (Tshs)**						**Wealth-class mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Low	4,900	7600	1,000	5,584	4,714	0	**3,966**
Medium	6,400	16,248	1,000	6,960	7,846	0	**6,409**
High	9,678	32,000	2,615	7,400	9,600	0	**10,216**
Village mean	**6,993**	**18,616**	**1,538**	**6,648**	**7,387**	**0**	**6,864**

Source: Survey Data, 2010

When asked if IWRM implementation had changed negative attitudes towards paying for water, the majority (49.3%) had a positive response (yes) while 32.7% had negative response (no), and 18% said they did not know. Reasons for the positive response were increased awareness on the importance of paying for water, improved water availability due to improved water resources management and increased realization on the value of water. These reasons were reported by 148 (49%) out of 300 respondents which constitute the study sample. Of these, the first two reasons were reported by 21% and 30% of the respondents respectively, while increased realization on the value of water was reported by a relatively large proportion of the respondents (48%). The question of water pricing and payment remains debatable. However, there is no doubt that payment for water sends a signal for the need to change water consumption as well as appreciate the value for water (Dungumaro, 2007). This is critical in that in spite of water being self-replenishing as noted by Balchin (1958), we cannot regard it as inexhaustible.

With regards to the reasons behind failure of IWRM to change negative attitude towards paying for water, 62% out of 97 respondents said they did not see the importance of paying for water use while they were still doing irrigation through traditional furrows which have been improved. The remaining proportion of the respondents said that rules and regulations governing water use payment has been poorly enforced (31%) and payment for water use has not minimized water use conflicts (7%).

4.2.3 IWRM Implementation and Water Availability

Research evidence shows that implementation of IWRM increased availability of water. The majority of the respondents (64%) indicated that IWRM implementation has improved water availability in the study area, and 20% said IWRM implementation reduced water availability. Fourteen percent said there is no change and a small proportion (3%) said they did not know. Results are posted in Table 4.10. The majority of the respondents in Rundugai, Kikafu chini, Kigonigoni and Kirya villages reported that the onset of IWRM has improved water availability in the study area while 50% and 62% of the respondents from Maore and Chekelei villages said that IWRM implementation has reduced water availability and few respondents said that there is no change (Table 4.10). Similarly, a large proportion of respondents were of the opinion that paying for water had improved water availability (59%) and a small proportion said that paying for water contributes to more water shortage (12%), while 29% reported that there was no relationship between payment and availability.

Table 4.10: Response on the link between IWRM implementation and water availability

IWRM implementation and water availability	**Response per village (%)**						**Mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
IWRM implementation has improved water availability	90	90	80	76	28	20	**64**
IWRM implementation has reduced water availability	2	0	4	0	50	62	**20**
There is no change	8	10	14	24	12	14	**14**
Do not know	0	0	2	0	10	4	**3**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey Data

With regards to the relationship between IWRM implementation and water use conflicts, 71% of the respondents mentioned that IWRM implementation has reduced water use conflicts while 22% said that IWRM implementation increases water use conflicts, and very few respondents reported that there is no relationship (4%). The rest, 3%, did not know. Analysis by villages indicates that Chekelei and Maore villages had a relatively high proportion of respondents (48% and 44% respectively), who said that IWRM implementation increases water use conflicts, large proportion of the respondents in Rundugai (88%), Kikafu chini (78%), Kirya (92%) and

Kigonigoni (88%) were of the opinion that implementation of IWRM has reduced water use conflicts. There is a relationship between water use conflicts and water availability since when there is water shortage, the likelihood of water use conflicts is high.

4.2.4 IWRM Implementation and Women Participation

Out of 300 respondents, 86% indicated that IWRM implementation has improved women participation in water management, while a few respondents had a negative response (5%) and the rest (9%) said that they did not see the relationship between IWRM implementation and women's participation in water management. Kogonigoni village had the highest proportion of respondents who had a positive response followed by Rundagai and Kirya, Kikafu chini, Chekelei and Maore (Table 4.11). Fourteen and twenty two percent in Maore and Chekelei villages respectively said that they did not know whether or not IWRM implementation had improved women participation.

Table 4.11: Implementation of IWRM and improvement of women participation (%)

Response	**Village**						**Mean**
	Rundugai	Kikafu chini	Kigonigoni	Kirya	Maore	Chekelei	
Yes	94	90	98	94	64	76	**86**
No	6	0	2	4	14	2	**5**
Do not know	0	10	0	2	22	22	**9**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey Data, 2010

When asked if there were restrictions to women participation in water use and management before IWRM implementation, 57% replied YES while 36% replied NO and 7% said they did not know. Those who said that there were restrictions for women participation in water management listed the restrictions as follows:

- Women were not allowed to approach water sources as the nature of their daily activities (firewood collection and cutting grasses for domestic animals) were alleged to be destructive.
- Taboos that restricted women from standing before men. This reduced their participation in decision-making organs such as water user associations and chances of leading others (leadership).
- Women were not allowed to participate in irrigation water management activities such as water distribution, intake opening & closing, furrow & canal cleaning and maintenance.
- Women were not allowed to approach water intakes.

The majority of the respondents (81%) were of the opinion that restrictions that limit women participation in water management are no longer conspicuous in the study area, while 10% said that the restrictions still existed and 9% said they did not know whether or not the restrictions still existed. Generally, IWRM implementation has improved participation of women in water management since in all study villages women were reported to hold some posts in water user groups/associations. For example, in Rundugai, Kikafu chini and Maore villages, women held treasurer posts in water user associations.

4.3 Link between IWRM Implementation and Livelihood Improvement

4.3.1 Economic Activities before and after IWRM Implementation

The majority of the respondents (91%) listed farming as their main economic activity with little variation between wealth classes. The high wealth class had the highest proportion (94%) of the respondents who listed farming as their main economic activity followed by the middle wealth class (91%) and the low income class scored 90%. Other economic activities listed with their percentage in brackets are livestock keeping (6%), business (2%) and casual labour (1%).

The onset of IWRM implementation did not interfere much with the economic activities in the study area. Farming has remained the main economic activity as reported by 94% of the respondents, others being business (3%), casual labour (2%) and livestock keeping (1%). However, within wealth classes the middle wealth class had the highest proportion (97%) of respondents who listed farming as their main economic activity followed by high wealth class (92%) and the low wealth class was the last with 89%.

4.3.2 Crop Production before and after IWRM Implementation

Results indicate that agricultural production increased after the IWRM implementation as a result of increased irrigated land. This observation suggests that there was an increase in irrigated water which led to increased irrigated land. Paddy, maize and beans had been produced by large proportion of the respondents before and after the implementation of IWRM. Others include vegetables such as tomatoes, cabbage, onions, spinach and cowpeas and bananas. The highest average plot sizes were those used to cultivate paddy (2.5 before and 3.5 after IWRM), followed by maize plots, beans plots, vegetables plots, banana plots and the lowest was cowpeas plots.

Table 4.12: Irrigated crops produced before and after IWRM implementation

Before IWRM implementation			**After IWRM implementation**		
Irrigated crops	**Mean area (Acres)**	**% of cultivating respondents**	**Irrigated crops**	**Mean area (Acres)**	**% of cultivating respondents**
Maize	2	87	Maize	2.5	92
Paddy	2.5	64	Paddy	3.5	58
Beans	2	45	Beans	2	55
Vegetables	1	10	Vegetables	2	20
Banana	1.5	5	Banana	1.8	5
Cowpeas	0.75	3	Cowpeas	1	4
Mean	**1.6**		**Mean**	**2.1**	

Source: Survey Data, 2010

Generally, the plot sizes increased from 1.6 acres before IWRM to 2.1 acres after IWRM, implying increase in agricultural production if other factors remained constant.

4.3.3 Water Related Sources of Income before and after IWRM Implementation

Farming, livestock, business and casual labour were reported as major water related sources of income as summarized in Table 4.13. The majority of the respondents listed agriculture as their

main source of income both before implementation of IWRM (79%) and after the implementation of IWRM (72%). On average, the income obtained from mentioned sources before IWRM was Tshs. 950,696 which had increased to Tshs. 2,657,558 after IWRM implementation. This implies the difference of Tshs. 1,706,862 and this income difference is significant (T = 12.24, P < 0.001). Increase in income after IWRM implies livelihood improvement.

Table4.13: Sources of income and mean annual income before and after IWRM implementation

Source of income	Respondents' response (%)		Average annual income (Tshs)		Income difference
	Before IWRM	After IWRM	Before IWRM	After IWRM	
Agriculture	79	72	2,239,050	7,128,703	4,889,653
Livestock	14	11	1,118,456	2,023,465	905,009
Business	4	7	257,778	998,065	740,287
Casual labour	3	10	187,500	480,000	292,500
Mean			**950,696**	**2,657,558**	**1,706,862**

Source: Survey Data, 2010

4.3.4 Food Security before and after IWRM Implementation

Food security was assessed in terms of months of food availability per year. Food security is another livelihood indicator. Before IWRM households in the study area had enough food for average of 6.5 months, but after IWRM implementation the number had increased to average 8.7 months with a difference of 2.2 months (Table 4.14). Comparison of wealth categories shows that the high wealth class had the highest average number of months of food availability followed by the middle wealth class and the low wealth had the lowest number of months of food availability per year both before and after IWRM implementation (Table 4.14). In general, implementation of IWRM has increased food availability and hence contributing positively to food security.

Table 4.14: Mean months of food availability before and after IWRM implementation

Village	Wealth classes	Mean months of food availability per year	
		Before IWRM	After IWRM
Rundugai	Low	7	8
	Medium	8	8
	High	10	10
Kikafu chini	Low	6	8
	Medium	7	9
	High	10	11
Kigonigoni	Low	5	7
	Medium	7	8
	High	8	10
Kirya	Low	6	7
	Medium	7	9

	High	8	10
Maore	Low	7	8
	Medium	9	10
	High	10	11
Chekelei	Low	5	6
	Medium	6	8
	High	8	10
Mean		**6.5**	**8.7**

Source: Survey Data, 2010

4.3.5 Household Possessions before and after IWRM Implementation

The number of household possessions has increased after IWRM implementation as shown in Table 4.15. Before IWRM, the low wealth category had no bicycles, but after IWRM the low wealth managed to own bicycles. Similarly, some respondents in the middle wealth category had capacity to own a motorcycle and television set after IWRM, while members of the high wealth category were able to own power tillers, *Plau* (Oxen) and cars after IWRM.

Table 4.15: Household possessions before and after IWRM implementation

Household possessions	**Wealth classes**		
	Low	**Medium**	**High**
Before IWRM	Farm plot	Farm plot	Farm plot
	Livestock	Bicycle	Bicycle
	House	Livestock	Livestock
	Cassette stereo player	Cassette stereo player	Cassette stereo player.
		House	Television set
			House
			Motorcycle
After IWRM	Bicycle	Farm plot	Farm plots
	Farm plot	Bicycle	Bicycle
	Livestock	Livestock	Livestock
	House	Cassette stereo player	Cassette stereo player
	Cassette stereo player	Television set	Television set
		House	House
		Motorcycle	Motorcycle
			Power tiller
			Car
			Plau (Oxen)

Source: Survey Data, 2010

4.3.6 IWRM Implementation and Livelihood Improvement

The majority of the respondents indicated that the implementation of IWRM improved their livelihoods (Figure 4.2). A small percentage of the respondents indicated that they did not know the difference in livelihoods before and after the implementation of IWRM.

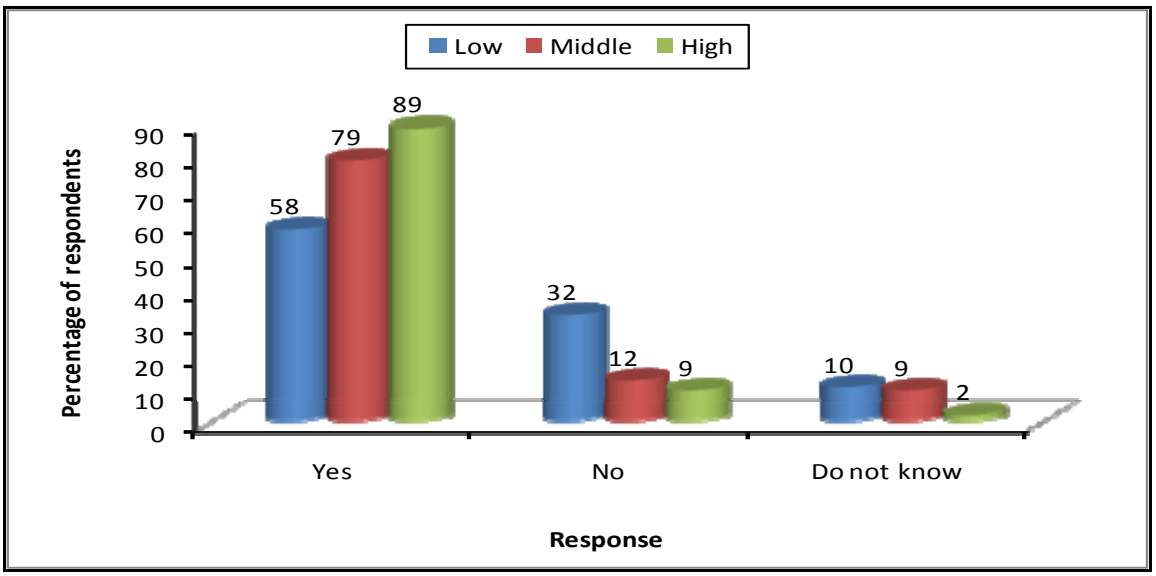


Figure 4.2: Response on the link between IWRM implementation and livelihood improvement

Source: Survey Data, 2010

4.4 Assets and Capabilities to Support Livelihood Using Water as Input

The majority of the respondents (82%) reported using their farm plots to produce crops particularly paddy, maize and beans. Money obtained from sale of crops produced on farms was used to buy household needs such as clothes and to pay school fees for children. In short, farm plots were used to get income and food for the family and hence contributing to poverty reduction and livelihood improvement.

4.4.1 Water Access before and after IWRM Implementation

Assessment on access to safe domestic water revealed that a large proportion of the respondents were of the opinion that there had been poor access both before and after IWRM implementation (Table 4.16). Comparison of wealth categories revealed almost similar trends before and after IWRM implementation .This means that implementation of IWRM has not improved access to safe domestic water in the study area.

Table 4.16: Response on domestic water access before and after IWRM implementation

Wealth classes	Response on safe domestic water access									
	Before IWRM					After IWRM				
	Very good	Good	Satisfactory	Poor	Very poor	Very good	Good	Satisfactory	Poor	Very poor
Low	6	16	29	43	6	4	14	22	56	4
Medium	5	14	22	55	4	9	17	29	30	15
High	7	17	20	46	10	7	20	35	36	2
Mean	**6**	**16**	**27**	**49**	**8**	**7**	**17**	**29**	**41**	**7**

Source: Survey Data, 2010

When asked to assess irrigation water access before and after IWRM implementation, respondents indicated that there were improvements in irrigation water access (Table 4.17). On average, the proportion of the respondents who indicated better access of irrigation water increased from 29% before IWRM implementation to 55% after IWRM implementation. Comparison of wealth categories showed that improvement of irrigation water access was higher for the low wealth category (from 24% before IWRM to 62% after IWRM implementation) compared to the other wealth categories (Table 4.17). This is because the majority of water users from low wealth categories have joined water user associations (groups) and this could have positive impact on irrigation water access.

Table 4.17: Response on irrigation water access before and after IWRM implementation

Wealth classes	**Response on irrigation water access**									
	Before IWRM					**After IWRM**				
	Very good	**Good**	**Satisfactory**	**Poor**	**Very poor**	**Very good**	**Good**	**Satisfactory**	**Poor**	**Very poor**
Low	3	24	36	22	15	9	62	14	7	8
Medium	6	33	44	17	0	6	54	22	15	3
High	5	31	41	18	5	6	50	21	17	6
Mean	**5**	**29**	**40**	**19**	**7**	**7**	**55**	**19**	**13**	**6**

Source: Survey Data, 2010

4.4.2 Status of Water Sources before and after IWRM Implementation

The study further revealed some improvement of status of water sources after IWRM implementation. With exception of encroachment for cultivation which showed an increasing trend before and after IWRM implementation, other sources of destruction (encroachment for settlement and tree cutting for various uses) showed a decreasing trend before and after IWRM implementation (Table 4.18). However, the cutting for various uses seems to be the source of destruction of water sources in the study area (Table 4.18).

Table 4.18: Response on water sources status before and after IWRM implementation

Water sources' status	**Response of the extent of destruction (%)**										
	Before IWRM					**After IWRM**					**Mean**
	Very low	**Low**	**Average**	**High**	**Very high**	**Very low**	**Low**	**Average**	**High**	**Very high**	
Encroachment for cultivation	34	36	24	24	20	31	29	26	44	25	**29**
Encroachment for settlement	12	22	29	11	19	42	35	27	21	20	**24**
Tree cutting for various uses	18	41	45	56	54	26	35	37	35	54	**40**
No destruction	36	1	2	9	7	1	1	0	0	1	**6**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Source: Survey Data, 2010

4.4.3 House Possession and Building Materials

Figure 4.3 presents responses on house possession among wealth categories. The majority of the respondents owned houses. The high wealth category was leading, followed by the middle wealth category and the low wealth category was the last. This implies that the proportion of respondents who lived in rented or family houses was higher in low wealth category than in other wealth categories.

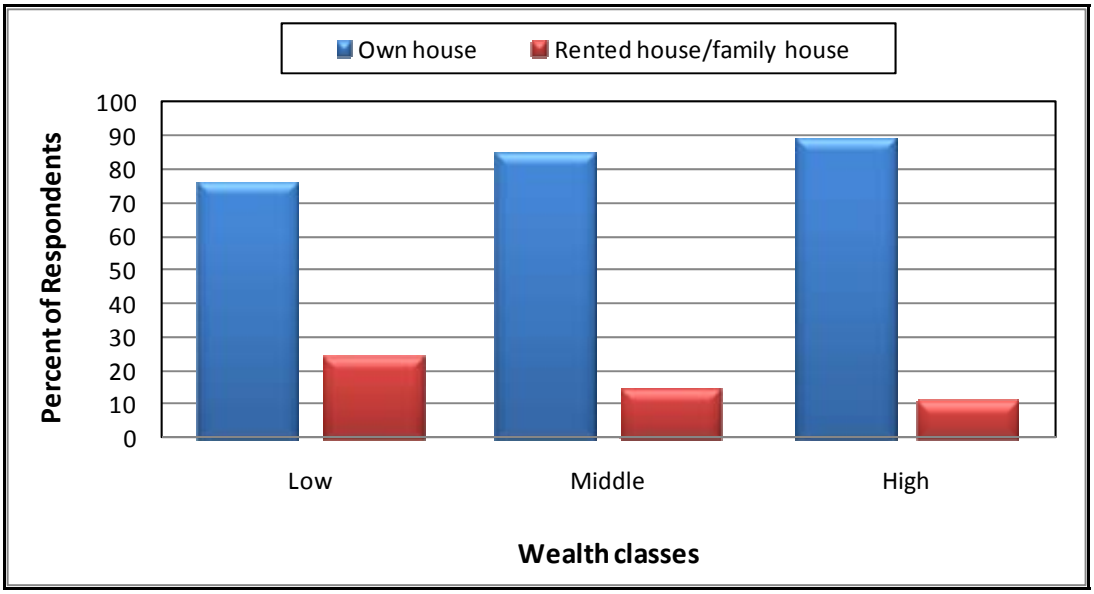


Figure 4.3: Response on house possession by wealth classes
Source: Survey Data, 2010

Results in Table 4.19 reveal that before IWRM the majority of the respondents roofed their houses with straw or reeds (58%), used wood and mud as wall materials (70%). Relatively a large proportion of the respondents (41%) were capable of using cement as floor material. After IWRM implementation, the majority of respondents were capable of building their houses using corrugated iron as roofing material (89%), burned bricks as walls material (50%) and cement as floor material (72%)

Table 4.19: Type of roofing, walls and floor materials for houses before and after IWRM implementation

House type	Material	Response (%)	
		Before IWRM	After IWRM
Roofing	Corrugated iron	42	89
	Grass	58	11
Walls	Burned bricks	6	50
	Raw mud bricks	21	13

	Concrete bricks	3	12
	Wood and mud	70	25
Floor	Cement	41	72
	Mud	28	42
	Tiles	0	1

Source: Survey Data, 2010

With regard to the use of electricity, the majority in the low income class (92%) and middle income class (77%) said that they did not have electricity in their houses. However, a large proportion of the high income class (56%) said that they had electricity in their houses. With exception of Kirya and Kigonigoni, the rest of study villages had access to electrical power.

4.4.5 Source of Credit before and after IWRM Implementation

The study revealed that respondents in the study area were getting loans either from relatives, friends, shops, bank and SACCOs. Table 4.21 shows sources of loans before and after IWRM implementation by wealth categories. Before IWRM implementation most of the respondents from all wealth categories were getting loans from relatives and friends, and few obtained loans from shops, bank and SACCOS. After IWRM implementation, the proportion of respondents who received loans from banks and SACCOS increased implying that IWRM implementation has improved the capacity of water users to obtain loans.

Table 4.20: Sources of loans by wealth classes before and after IWRM implementation

Sources of loans	**Wealth classes**	**Response of sources of loans (%)**	
		Before IWRM	**After IWRM**
Relatives	Low	28	16
	Medium	29	14
	High	22	3
Friends	Low	48	38
	Medium	38	19
	High	28	7
Shops	Low	7	16
	Medium	5	10
	High	10	6
Bank	Low	0	2
	Medium	1	6
	High	2	37
SACCOS	Low	4	8
	Medium	2	43
	High	8	54

Source: Survey Data, 2010

4.5 Strengthening Local People's Capacities to Implement IWRM for Poverty Alleviation

Out of 300 respondents, 63% were of the opinion that IWRM implementation has positive contribution to poverty alleviation, while 37% said that implementation of IWRM is linked with poverty alleviation. The reasons for positive response were due to the fact that IWRM implementation has increased water availability, reduced water use conflicts thereby improving irrigation, which has positive effects on food availability and income improvement. As illustrated in Figure 4.4, the majority of respondents said that IWRM has been successfully implemented in the study area due to its positive contribution to livelihood improvement. However, a slight difference has been observed among wealth classes. They feel that implementation of IWRM has strengthened their capacity to improve livelihood and reduce poverty.

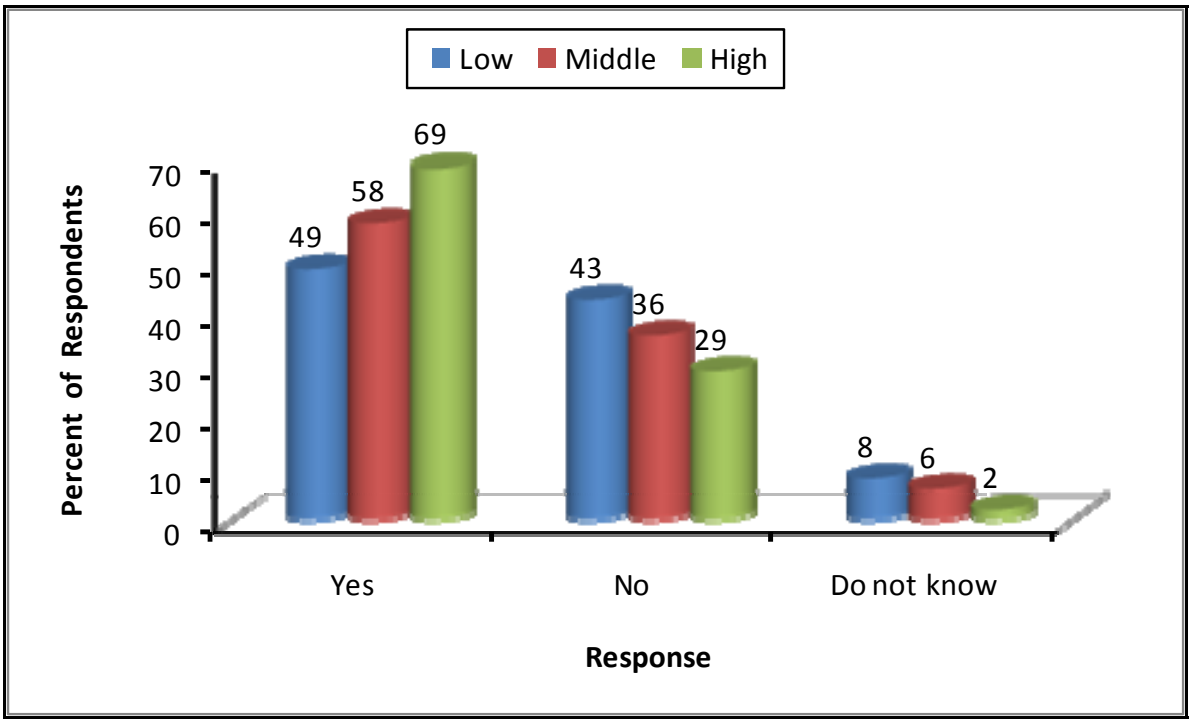


Figure 4.4: Response on whether IWRM has successively been implemented in the study area

Source: Survey Data, 2010

The high wealth category had the highest proportion of respondents (69%) who said that implementation of IWRM has been successful, followed by the middle wealth class (58%) and the low wealth class scored 49%. For those who reported that IWRM has not been successfully implemented and those who did not know, the low wealth class was leading followed by the middle wealth class and lastly the high wealth category with 29%. It is fair to argue that success in IWRM implementation is positively linked to poverty alleviation since the indicators which show success in IWRM implementation are also the indicators that contribute to poverty alleviation.

Indicators show that IWRM implementation had positive contribution to poverty alleviation. Observed also were improved community income, food security, availability of water. Annual income in the study area has increased three times from average of 950,696 Tshs before IWRM to 2,657,558 Tshs after IWRM. Food security was assessed in terms of periods of food availability. In this case, IWRM implementation has increased months of availability from 7 (on average) before IWRM to 9 (on average) after IWRM implementation.

With regards to water availability, IWRM implementation has reduced distance to sources of domestic water from the average of 2.4 km before implementation of IWRM to 0.8 km after the implementation of IWRM. Time spent to get domestic water was reduced from 2.5 hours before IWRM to one hour after IWRM. This implies that after IWRM people have more time for farming and carrying out other economic activities. This suggests that the implementation of IWRM increased chances of people to improve livelihood and alleviate poverty. In general, the majority of the respondents (75% on average) said that IWRM implementation has a positive contribution to the improvement of livelihood, which is a proxy indicator of poverty alleviation.

However, with regard to community empowerment to understand the link between IWRM implementation and poverty alleviation, the majority of the respondents (75%) had negative response (No) while 21% had positive response (Yes) and five did not know the relationship (Table 4.22). This observation calls for educational programmes on the assumption that people will devote more time and effort to IWRM if they are informed of tangible benefits.

Table 4.21: Response on community empowerment to understand link between IWRM implementation and poverty alleviation (%)

Response	Village						Wealth classes			Group mean
	RUG	KFC	KIG	KRY	MAR	CKL	Low	Meddle	High	
Yes	50	44	18	0	2	10	11	23	33	**21**
No	48	44	80	92	96	88	80	75	63	**75**
Do not know	2	12	2	8	2	2	9	2	4	**5**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table Legend: RUG = Rundugai, KFC = Kikafu chini, KRY = Kirya, MAR = Maore, CKL = Chekelei
Source: Survey Data, 2010

Comparison of villages revealed a similar trend in almost all the study villages except Rundugai and Kikafu chini which had a relatively large proportion of respondents who had positive opinions on community empowerment to understand the link between IWRM implementation and poverty alleviation (Table 4.21). Within wealth categories, low wealth category had the highest proportion of respondents (80%) who had negative opinions on community empowerment, IWRM implementation and poverty alleviation.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

Results indicate that more women than men fell under the low wealth category. This could be a result of the low status of women which results in inadequate ownership of various resources, including land. The same observation was made by Chant (2003). Just like the case is for the majority of Tanzanians living in rural areas, respondents' main economic activity is agriculture. Fishing and business are also done at a small scale.

The majority of the respondents (92%) are aware of the period that the implementation of IWRM started in the PRB. The perception by the majority that IWRM implementation started after 1990s corresponds well with the establishment of the Pangani Basin Water Office and Board in 1991 and 1992, respectively. This is because formal implementation of IWRM could not have been possible in the absence of the Basin Water Office and Board.

Parallel to their awareness of the period of implementation of IWRM, respondents are also informed of the indicators of the implementation of IWRM. They mentioned the following indicators:

- ✓ formation and joining water user groups and associations;
- ✓ water use payment system;
- ✓ improvement of traditional furrows;
- ✓ women participation in irrigation water management; and
- ✓ management of water and allied resources holistically.

The ability to mention indicators of implementation of IWRM and the period that implementation of IWRM started suggests that respondents could confidently tell the difference in their livelihood before and after the implementation of IWRM.

One of the principles of IWRM is adequate community participation. Results from the present study indicate that the respondents participate in IWRM implementation either through joining water user groups/associations, paying water use fees, conservation of water catching areas or participating in environmental education campaign. In this regard, we can fairly conclude that there was high level of community participation.

While farming remained the main economic activity in the villages of study, the implementation of IWRM resulted in the improvement in their livelihood. Among variables which suggest improvement in livelihood include increase in the plot sizes from 1.6 acres before IWRM to 2.1 acres after IWRM implying increase in agricultural production. Furthermore, the income obtained before IWRM was Tshs. 950,696 which had increased to Tshs. 2,657,558 after IWRM implementation. While we are in cognizant that there could be other factors which might have contributed to the increase in income, but in our study, these results suggest that implementation of IWRM has resulted in improved livelihood through increased income.

Based on the above findings we can conclude that IWRM is important for both poverty alleviation and improved livelihood. In this regard, we recommend that where IWRM is yet to be implemented, measures should be put in place to ensure its implementation. Furthermore, adequate community participation is paramount in order to positively change the lives of the people and register significant results. Successful IWRM should ensure a meaningful public participation[5].

[5] For a detailed discussion on public participation see Dungumaro and Madulu (2003).

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