

**INFLUENCE OF WATER USERS' ASSOCIATIONS FOR THE
SUSTAINABILITY OF WATER RESOURCES MANAGEMENT: A CASE
STUDY OF MKOJI CATCHMENT IN RUFJI BASIN**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER IN PROJECT
MANAGEMENT**

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CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by The Open University of Tanzania, a dissertation entitled: **“Influence of Water Users’ Associations for the Sustainability of Water Resources Management: A Case Study of Mkoji Catchment in Rufiji Basin”**. In partial fulfilment of the requirements for the degree of Master of Project Management of the Open University of Tanzania.



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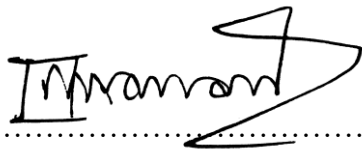
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DECLARATION

I, **Tumaini Lukanazya Lyamongo**, declare that, the work presented in this dissertation is original. It has never been presented to any other University or Institution. Where other people's works have been used, references have been provided. It is in this regard that I declare this work as originally mine. It is hereby presented in partial fulfillment of the requirements for the degree of Master of Project Management of The Open University of Tanzania.



A handwritten signature in black ink, appearing to read 'Tumaini Lukanazya Lyamongo', is written over a horizontal dotted line. The signature is stylized and cursive.

Signature

.....

Date

DEDICATION

This dissertation is dedicated to my parents Ladislaus Lyamongo and Rozamistika Mnyaga who have given me invaluable education opportunities and to my brother, Prof. Baltazar Namwata Lyamongo who has been emotional anchor through my entire life.

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ABSTRACT

Across the world, the wellbeing of societies depends heavily upon the ability to harness water as a productive resource. Competition for water resources among different users in the basin creates challenges in managing and allocating these resources. The general objective of the study was to investigate the influence of water users' associations (WUAs) for the sustainability of water resources management with reference to Mkoji catchment in Rufiji basin. Cross-sectional study design was used in the study whereby a sample size of 50 participants who participated in the interview and FGDs was used that included WUAs leaders and members. Qualitative data from in-depth interviews and FGDs were analysed using content analysis. The findings indicates that, WUAs are facing challenges of inadequate technical and financial capacity with conflicting roles and responsibilities. Yet, WUAs have facilitated with little funds led to improper utilization and management of the catchment area. Also, WUAs has been incorporated in various activities such as participating in meetings with heterogeneous groups, managing afforestation and restoration of trees and other species something that discourage soil erosion and siltation. However, the unsuitable design of WUAs has led to a situation in which the authority of the WUA is bypassed. Thus, in their current form, WUAs are inadequately shaped to undertake the role of monitoring formal water use permits. It is recommended that without its local arm, the basin water board has little leverage to control water use throughout the basin.

Keywords: *Ability to harness water, productive resource, Mkoji catchment, Rufiji basin*

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LIST OF ABBREVIATIONS

BWB	Basin Water Board
FGDs	Focus Group Discussions
IWRM	Integrated Water Resources Management
KIIs	Key Informants Interview
MSC	Mkoji Sub-Catchment
RBWB	Rufiji Basin Water Boards
URT	United Republic of Tanzania
WRM	Water Resources Management

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

Across the world, the wellbeing of societies depends heavily upon the ability to harness water as a productive resource (Noel, 2011). Concerns over whether there is sufficient quantity and quality of water resources to meet the needs of society have grown and entered the realm of uncertainty due to climate change and increasing demand for this resource (World Bank, 2019). In Africa, agriculture is the main user of freshwater resources, accounting for almost 70% of the total annual use, which has affected the natural flows of water and sediments, and thus the riverine ecosystems (WWF, 2010). Chepyegon and Kamiya (2018) reported that the rapid population growth and urbanisation in sub-Saharan Africa where climate variability is high, increases the need to think carefully about water challenges. East African countries' development goals including Tanzania's may indeed be jeopardised by water challenges. The ways that stakeholders participate in water resource management (WRM) vary and can have wide-ranging environmental, social, political and economic consequences (Butler and Adamowski 2015).

Water is a finite vulnerable resource which is under pressure; and when it is available in adequate quantities and in good quality it becomes a primary input for a whole array of productive activities (URT, 2002). Deliberate efforts are therefore needed to protect and sustain the water resource and ensure that it is used efficiently and effectively for the benefit of present and future generations (URT, 2002). In 1981,

Tanzania adopted river basin management and established the River Basin Water Boards (RBWB) to manage its waters resources, in which formal and informal community participation were recognized (Silas, 2014). RBWBs necessitated the establishment of water catchment areas to sustain life by providing food and water for communities, contribute substantially to the economy and provide the foundation for rich and diverse natural environment (Ndelwa, 2014). Thus, in order to implement Integrated Water Resources Management (IWRM) according to good practice, governments and development agencies have promoted the setting-up of Water Users Associations (WUAs) as a broadly applicable model for water management at the local level (Ndelwa, 2014).

WUAs are promoted as key to the rolling out of IWRM principles through a participative process (Cooper et al., 2008). Moreover, evidence shows that catchment systems face enormous and ongoing threats from human activities and thus reducing the quality of life over the coming decades (Mbuya, 2004). Catchment areas have been conserved in order to enable water users participate into their daily activities in an integrated manner (Noel, 2011). Sufficient and clear incentives for participation are critical to the success and sustainability of WUAs, perhaps more than any other single factor (Subramanian et al. 1997). Water users' associations (WUAs) exist as another mechanism to facilitate stakeholder participation in water resources management (WRM) (Silas, 2014). These WUAs are often formally recognized and nested within a clearly established hierarchy for water management; they represent a managed decentralization of WRM, operating at a catchment scale with inhabitants

of that catchment but linked to a larger basin or national-scale institution (Subramanian et al. 1997).

WUAs are designed as the lowest participative organisations for water resources management within defined basins (Butler and Adamowski, 2015). They cover segments of watersheds, and are broadly responsible for water conservation activities, conflict management over water issues, and water allocation to irrigators through a permitting system (Noel, 2011). The Tanzanian Water Resources Management Act of 2009 allows WUAs to ‘acquire and operate a permit’, and to have a say during the permit distribution process managed by the basin authority. Furthermore, WUAs must theoretically check that water users including irrigation schemes abstract water within the frame of the allocated water permit (Ndelwa, 2014). In theory, and according to the Water Resources Management Act of 2009, the WUA should be the entity advising the basin authority on these tasks, as a close watcher of daily abstractions (Ministry of Water and Livestock Development, 2009).

A study conducted by Derman and Prabhakaran (2017) reported that water user associations in India were responsible for the management and maintenance of irrigational canals, resolving water-related disputes among users while collecting the irrigation charges and agriculture and land-water management related tasks. Noel (2011) asserted that WUAs which are considered the lowest unit in the IWRM framework of Tanzania have a vital role in water management, allocation and spreading water-related information within communities. Moreover, the Mkoji sub-catchment, one of the most populated sub-catchments in Tanzania, is characterized

by its multiple water users, including hydropower production, agriculture, livestock and other land uses (SAGGOT, 2012). World Bank (2019) reported that the growth of the activities in the area to produce food crops has increased the conflicts between water users at the upstream, middle and downstream areas. The multiple users and the intensive water use in the sub-catchment have increased the abstraction and the encroachment of the reserved areas, such as forests, which have led to deforestation and poor agricultural activities. According to WWF (2010), the issue of decreased environmental flows, water user conflicts, and the decrease in the size of the wetland in the sub-catchment contributed to the decrease in the flow of rivers and has affected downstream users.

Noel (2011) asserted in his study that although WUAs appear to be functional due to their registered existence on paper (as officially recognised organisations with by-laws and official organisational meetings), they are in fact symptomatic of isomorphic mimicry, in that the implementation of their by-laws is lacking. In addition, the institutional logic behind their shaping is flawed; WUAs in the GRRC are unable to function effectively, as they are held accountable upwards to the regulatory (basin) authority, and downwards to their local community claiming ancestral rights over water. Nonetheless, the study conducted by Silas (2014) reported that the unsuitable design of WUAs has led to a situation in which the authority of the WUA is bypassed. Therefore, in their current form, WUAs are inadequately shaped to undertake the role of monitoring formal water rights. Hence without its local arm, the basin authority has little leverage to control water use throughout the basin.

Moreover, research by Ndelwa (2014) conducted in the Ilonga sub-catchment of the Wami/Ruvu basin in Tanzania reported that WUAs had a good role in managing water conflicts in the basins and the water-related conflicts decreased from 22% to 4% before and after the formation of the WUAs, respectively. Yet, the above studies bring about a question to ponder on whether these WUAs are capable of attaining environmental, economic and social sustainability. However, it was found that no or a few studies focused on the influence of WUAs to facilitate the sustainability of water resources management in Rufiji basin. It is from this backdrop that this study investigated the influence of WUAs for the sustainability of water resource management at Mkoji catchment area in Rufiji basin.

1.2 Statement of the Problem

Competition for water resources among different users in water basins creates challenges in managing and allocating these resources (SAGGOT, 2012). Ndelwa (2014) reported that the uncertainty around water availability and climate change in basins is therefore a high risk to agricultural investments. The reason is that the population around basins has increased significantly, challenging progress on a number of water development indicators. There are already important trade-offs in some basins (including water conflicts) related to balancing the available water between irrigated agriculture, livestock herders, hydropower generation and environment (World Bank, 2019). Despite Tanzania's robust economic growth rates and its potential to be a regional food basket, levels of poverty and food insecurity remain stubbornly high (Ndelwa, 2014). With over 12.9 million Tanzanians below the poverty line, and 85% of those living in rural areas, agriculture presents the best

opportunity for reducing poverty and achieving food security in Tanzania and G8 priority (SAGGOT Annual Review, 2013).

The Water Resources Management Act (2009) provides for establishment of Water Users Associations (WUAs), Catchment and Sub catchment committees to enhance water resources management at lower levels. The involvement of WUAs in water-land-related activities indicated their role in the restoration of the environment and the ecosystem (Ndelwa, 2014). This improves the ability of people to cope with the effects for climate change by improving water availability, ensuring it is sustainable and water climate resilient (Silas, 2014). However, such WUAs are yet to be sustainable in most parts of the basin; but a few that have been established are already facing a number of challenges ranging from inadequate technical and financial capacity to conflicting roles and responsibilities (Noel, 2011). Despite the efforts made by governmental and non-governmental organizations in forming and supporting WUAs, little is known about the influence of water users' association in Mkoji catchment, Rufiji Basin. WUA leaders have a mandate in supervising the use of water in the schemes through the collection of fees and making sure that water is returned to the rivers for ecosystem needs. Also, WUA leaders have the role to preserve the environment for economic and social sustainability of water resources management at Mkoji sub-catchment. Moreover, this is questionable from the fact that this is the most populated sub-catchment in the uppermost part of the Rufiji basin in Tanzania with critical users downstream and it is vulnerable to water shortages (SAGGOT Annual Review, 2013). I have found few studies that have focused on the influence of WUAs to facilitate the sustainability of water resources

management in Rufiji basin. It is from his background that this study aimed at investigating the influence of water users' association for the sustainability of water resources management in Mkoji catchment.

1.3 Research Objectives

1.3.1 General Objective

The main objective of the study was to investigate the influence of water users' associations (WUAs) for the sustainability of water resources management with reference to Mkoji catchment in Rufiji basin

1.3.2 Specific Objectives

The study was guided by the following specific objectives;

- i) To explore the impact of WUAs in facilitating environmental sustainability of water resources management at Mkoji catchment
- ii) To assess the impact of WUAs in facilitating economic sustainability of water resources management at Mkoji catchment
- iii) To examine the impact of WUAs in facilitating social sustainability of water resources management at Mkoji catchment

1.4 Research Questions

This study was guided by the following specific research questions;

- i) What is the impact of WUAs in facilitating environmental sustainability of water resources management at Mkoji catchment?

- ii) What is the impact of WUAs in facilitating economic sustainability of water resources management at Mkoji catchment?
- iii) What is the impact of WUAs in facilitating social sustainability of water resources management at Mkoji catchment?

1.5 Significance of the Study

The findings of this study contribute to knowledge provision among WUAs and other players on the need to facilitate environmental, economic and social sustainability of water resources for the purpose of making sure that the catchments are well maintained and managed. Also, the findings of this study are expected to add value to policy makers in carrying out their duties and enabling them plan for better future while insisting on monitoring and evaluating the projects for their sustainability. Moreover, the study findings might be used as reference for the researcher to accomplish his degree of Master of Project Management of the Open University of Tanzania.

1.6 Scope of the Study

The study focused on Mkoji catchment area in Rufiji basin with 38 WUAs. Out of 38 WUAs one was (Mkoji WUA) selected for the study. It further explored the environmental, economic and social sustainability of water resources management at Mkoji catchment.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Overview

This chapter presents the literatures from different authors that underpin the study. It starts presenting the definitions of key terms, then theoretical review. It further presents the empirical literatures and finally the conceptual framework.

2.2 Definition of Key Terms

2.2.1 Water User Associations (WUAs)

These are formal organizations created to bring together water users for the purpose of managing a shared irrigation system. Moreover, a Water Users Association (WUA) is a non-profit organization that is initiated, and managed by the group of water users along one or more hydrological sub-systems (distributory canals which are the higher level than a watercourse) regardless of the type of farms involved (Ndelwa, 2014). By water users it means the ordinary cultivators of land, individual members of lease-holding farms and shirkats, owners of private and dehkan farms, owners of home garden plots, etc (Butler and Adamowski, 2015). These are the potential members of the WUAs, who pool financial, material, technical and human resources for the operation and maintenance of the irrigation and drainage system within their jurisdiction for the benefit of all the members. The membership in the WUA is based on contracts and/or agreements between the members and the WUAs (Noel, 2011).

2.2.2 Sustainability of Water

Sustainability of water, means ensuring that there is enough water to meet multiple needs from agriculture to municipal and industrial purposes (Silas, 2014). Sustainable water also means that the economics stack up in matching supply and demand and the water delivery process is as efficient as possible. It also means water supply will remain consistent, despite climate change impacts, such as a lack of rainfall and drought, or too much rain and being flood resilient (Komakech et al., 2011). Water sustainability, meanwhile, can also mean effective and holistic management of water resources (Muyungi et al., 2007).

2.2.3 Water Resources Management

This is the process of planning, developing and managing water resources in terms of both water quantity and quality, across all water uses. It includes the institutions, infrastructure, incentives and information systems that support and guide water management (Ndelwa, 2014). It is also the activity of planning, developing, distributing and managing the optimum use of water resources (Komakech *et al.*, 2011).

2.3 Theoretical Review

The theory that was used to govern the study is transparent water management theory. The theory is hereunder elaborated.

2.3.1 Transparent Water Management Theory

This theory was developed by Naim Haie in 2020 with its first publication in 2021. The theory is vital for water policy, planning and practice due to the high complexity

inherent in water use systems, which, in turn, demands a coherent and clearly defined terminology for transparent and accurate analysis. In this theory, Haie (2021) provided a system of ideas intended to explain general principles based on five foundational ideas using independent principles, and a basic law of nature in order to guide water management processes toward sustainability. Furthermore, his thoughts of developing a theory for water use systems emerged when the author was reading the book of the late eminent scholar John Rawls entitled “A theory of Justice”. In this famous book, the author advanced a theory based on three fundamental ideas; one of which (the Difference Principle) gave impetus to some of the important developments of the theory.

Haie (2021) states that the emergence of a universal aggregative indicator and an objective distributive approach for water use systems are significant outcomes of the theory, which served as the foundation. The author stated that there is a fundamental difference between descriptive and performance indicators of a water use system. The former responds to the question “What is happening?”, and the latter focuses on the questions, such as “Does it matter? Are targets reached?” To answer these questions, Haie (2021) used efficiency as a performance indicator, which helps to attain more of the things valued and develop systemic, comprehensive and objective performance indicators based on a universal principle integrating the differentials of the three pillars of water management, namely water quantity, water quality and water benefit. These reveal trade-offs among the three pillars at three levels of management with climate and energy descriptors and stakeholder enablers.

Haie (2021) coined the idea of equity that is related to development, which is a process of expanding the real freedoms that people enjoy. Furthermore, freedom can be distinguished both from the means that sustain it and from the achievements that it sustains. In this theory, the author focused on water as a means having in mind that sustainable water equity means a fair share considering the water needs and the ability to use the water efficiently. These two requirements, i.e., need and efficiency, have degrees (i.e., they are not binary) and correspond to two principles: distributive and aggregative, respectively. In progressing in the two requirements, the author developed an approach to enable transparent and impartial communication, to focus attention on problematic situations through categorization, and to elaborate policy guidelines in order to coherently and consistently solve management issues (Burk, 2018).

The theory helps the users of water to appreciate the wide range of situations that the concepts and tools presented in theory should be employed in order to get a better insight into their functioning. The application examples are about urban water and wastewater cycle, urban water equity, irrigation under water scarcity, water-energy-food entangled systems, and the combined impact of an urban area and an irrigation zone on their common source of water, which is a river with a minimum water requirement. This theory might explain and solve the problems associated with an important water supply myth that may be found in catchment areas such as Mkoji in Rufiji basin.

2.4 Empirical Review

A study by Facius (2008) conducted in Tanzania on an analysis of relationship between institutions and WUAs conflict and cooperation, documented conflicts among small-holder irrigators. Cross-sectional design was used with the aid of qualitative analysis for a sample size of 45 participants. It was found that scarcity of water and conflicts about water were reported to be mainly connected with irrigation. The most serious of such conflicts were those between formal water rights and irrigators using water according to the indigenous system, especially between the two different small-holder irrigators. It was further found that the intensive water uses in connection with the improved small-holder irrigation schemes to make them economically sustainable (the heavy investments) led to a situation where many traditional irrigators in the study area faced water scarcity and in some cases were not able any more to get sufficient water to fields which were previously used for rice cultivation. It was recommended that using WUAs would reduce such conflicts.

The study conducted in Wami/Ruvu Basin by IUCN (2010) in Tanzania indicated that sub-catchment WUAs were the lowest level of management within water management structure. Qualitative approach and analysis were used along with a sample of 50 participants. It was found that the WUAs were aimed at assisting the Basin Water Office in the managing of water sources in the Basin. Such associations were responsible for local-level management of allocated water resources, mediation of disputes among users and between groups within their areas of jurisdiction, collection of data and information, participation in the preparation of water utilization plans, conservation and protection of water sources and catchment areas,

efficient and effective water use and ensuring return flows, enforcement of the law and implementation of conditions of water rights, and control of pollution. It was recommended that, WUAs would form sub-catchment committees and provide representatives on Basin Boards and Catchment Committees for the enhancement of water resources management.

Ndelwa (2014) in his study on the role of WUAs in enhancing Ilonga catchment area found that engaging farmers in management and decision-making can increase water productivity and increase transparency and accountability in water management. The study aided by exploratory design with qualitative approach of 35 participants found that the formation of WUAs was the basis to fulfilling the pillars of IWRM, including equity. It was recommended that the sustainability of the environment and efficiency with the associations were expected to serve as technical organs when knowledge is provided to them for the sustainability of Wami/Ruvu basin.

Dyer et al., (2014) in their study on the effects of climate change on the sustainability of catchment areas, found that climate change is expected to have great impacts on the global hydrological cycle. Climate change and its variability caused extremities such as floods that have affected the quality of the water in rivers. It was found that many climate change studies conducted in Tanzania showed an increase in the rainfall in some parts of the country and a decrease in rainfall and increase in temperature in other parts, which would lead to extreme natural events such as floods and drought. Climate change was associated with the poor management of land and water resources. It was further found and recommended that the multidimensional

value of the ecosystem services reflected the interrelationship between ecosystems and human activities where the utilization of WUAs was deemed essential.

Muyungi et al., (2007) in their study on management of land use found that with plans to unlock its development potential particularly through the agricultural sector, Tanzania has been intensifying the use of its resources to increase food production. Aided with cross-sectional design and qualitative approach and analysis, it was found that, the destruction of catchments worsened the energy crisis and land degradation, especially in the central semi-arid areas and the dry sub-humid areas in the southern highlands of Tanzania. It was recommended that formalisation of access is gradually taking place in the GRRC, and responsibilities were given to the Water Users Associations to facilitate its implementation.

Dickens (2010) carried a study on environmental flow assessments and found that assessments have been carried out in a number of basins in Tanzania such as the Pangani, Wami-Ruvu, Rufiji (all in Tanzania), and Mara basins. In the Pangani River basin, Dickens (2010) reported that implementation of environmental flows was awaiting the conclusion of the project. Among the limitations and gaps that Dickens (2010) reported were a lack of information on ecological importance; resources quality not being described; insufficient local involvement; not all sections of the project were well focused on environmental flows; and stakeholder involvement was inadequate.

Dirwai et al., (2020) conducted the analytical study that systematically reviewed the evidence about the IWRM water strategy model. The study analysed the IWRM

strategy advances and practical implications it had, since inception on effective water management in East, West and Southern Africa. The study adopted the Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA-P) and the scoping literature review approach. The results revealed the systematic literature review detailed the adoption, policy revisions and growing/emerging policy trends and issues (or considerations) on IWRM in East, West and Southern Africa. Thematic analysis derived four cross-cutting themes that contributed to IWRM strategy implementation and adoption. The identified four themes were donor effect, water scarcity, trans boundary water resources, and policy approach. The output further posited questions on the prospects, including whether IWRM has been a success or failure with the African water resource management fraternity.

2.5 Conceptual Framework

Figure 2.1 provides the conceptual framework. This is defined as an abstract idea or a theory used to develop new concepts or to reinterpret existing ones (Yin, 2003). It gives the relationship between the dependent and independent variables.

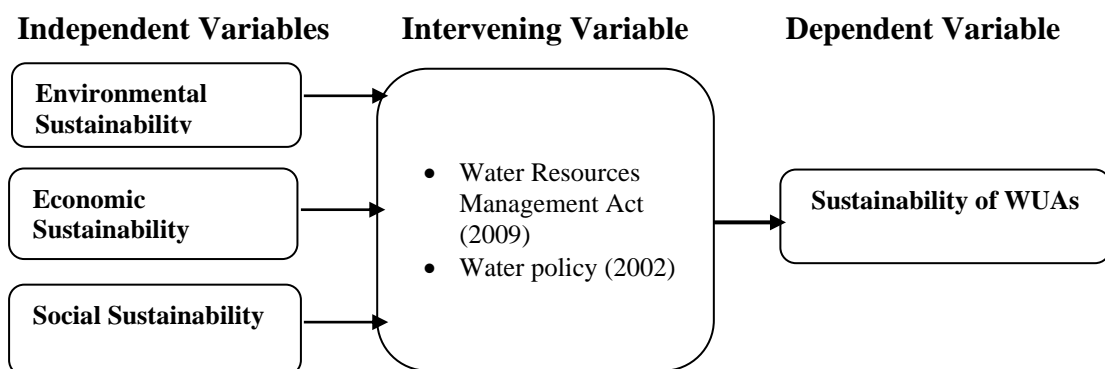


Figure 2.1: Conceptual framework

Source: Researcher's Own Model (2021)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Chapter Overview

This chapter presents the research methodology. It commences with the presentation of research paradigm and approach, then the research design and area of the study. It further presents the population, sample size and strategies. Likewise, the chapter presents data collection tools, analysis procedures and ethical issues.

3.2 Research Paradigm

A research paradigm is a belief about the way in which data about a phenomenon should be gathered, analysed and used. The term epistemology (what is known to be true) as opposed to doxology (what is believed to be true) encompasses the various philosophies of research approach. In other words, it is the basis of the research, which involves the choice of research strategy, formulation of the problem, data collection, processing, and analysis (Greene *et al.*, 2010). There are four main trends of research paradigm that are distinguished and discussed in the works by many authors: the positivist research paradigm, interpretivist research paradigm, pragmatist research paradigm, and realistic research paradigm. The Positivist research paradigm claims that the social world can be understood in an objective way. In this research philosophy, the scientist is an objective analyst and, on the basis of it, dissociates himself from personal values and works independently. The opposite to the above-mentioned research philosophy is the interpretivist research paradigm, where a researcher states that on the basis of the principles it is not easy to understand the

social world. Interpretivist research philosophy says that the social world can be interpreted in a subjective manner. The greatest attention here is given to understanding of the ways through which people experience the social world. Interpretivist research paradigm is based on the principle which states that the researcher performs a specific role in observing the social world. According to this research philosophy, the research is based and depends on what the researcher's interests are. On the other hand, the Pragmatist research paradigm deals with the facts. It claims that the choice of research philosophy is mostly determined by the research problem. In this research philosophy, the practical results are considered important. Thus, researchers have freedom of choice. They are free to choose the methods, techniques, and procedures that best meet their needs and scientific research aims. Moreover, the pragmatists do not see the world as absolute unity. Finally, the Realistic research paradigm is based on the principles of positivist and interpretivist research philosophies. Realistic research paradigm is based on assumptions that are necessary for the perception of subjective nature of the human (Greene *et al.*, 2010). Therefore, in this study, a realistic research paradigm was used as it focuses on objective and subjective manner of interpreting issues.

3.3 Research Approach

The study applied a qualitative approach to obtain the required data. Qualitative approach aims to explore and to discover issues about the problem on hand, because very little is known about the problem. Qualitative approach uses soft data and gets rich data (Cresswell, 2009). According to Myers (2007) qualitative approach is designed to help researchers understand people, the social and cultural contexts

within which they live. Such studies allow the complexities and differences of worlds-under-study to be explored and represented. Qualitative data sources include observation and participant observation (fieldwork), in-depth interviews and focus group discussions (Cresswell, 2009).

3.4 Research Design

The study employed cross-sectional study design whereby in-depth interview and focus group discussions (FGDs) were used to solicit information from the water users' associations in Mkoji catchment area. Yin (2003) defines a cross-sectional design as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly defined. Cross-sectional design is especially useful in situations where contextual conditions of the event being studied are critical and where the researcher has no control over the events as they unfold.

Therefore, given the interpretive position adopted in this research and the nature of the research questions, the cross-sectional design is considered the most appropriate design to employ because it provides a systematic way to collect data, analyze information and report the results, thus understand a particular problem or situation in great depth. Cross-sectional design makes use of multiple methods of data collection such as interviews, FGDs document reviews, archival records, direct and participant observations and subsequently thick descriptions of the phenomena under study (Yin, 2003).

3.5 Study Area

The study was conducted in Mkoji catchment. The reason is that no or a few studies have focused on the influence of WUAs to facilitate the sustainability of water resources management in this catchment area. The Mkoji sub-catchment (MSC) with about 150,000 people in 3400 km², is located in the southwest of Tanzania between the latitudes 8°10'0" and 9°5'0" south, and longitudes 33°35'0" and 34°10'0" east. MSC is one of the uppermost sub-catchments of the Rufiji River basin. Its upper zone receives water from the Poroto and Chunya mountains. The climate of the studied area is unimodal, with two seasons: a rainy season between November and April and a dry season between May and October (URT, 2019). The annual rainfall ranges from 600 mm to 800 mm in the lowlands and 1500 mm in the highlands. MSC is characterized by a various number of water users from upstream to downstream, which has intensified the pressure on the water resource and to some extent caused conflicts between users, especially during the dry season. Water uses include irrigation, domestic and livestock (76, 18, and 6%, respectively) (Ndelwa, 2014). The available water resources during the rainy season are estimated to be 3190 Mm³. Socioeconomic activities in the area include crop production, livestock keeping, fishing, business, and some industries (WWF, 2010).

3.6 Population

Copper and Schindler (2008) defines a study population as a set of elements, or objects from which statistical sample is drawn. Equally, Saunders *et al.*, (2003) defines a study population as the total group of elements, possessing common observable characteristic that a researcher is interested in conducting a study; a

population constitutes the total sum of objects and elements from which a researcher wishes to draw conclusions. According to Sekaran (2003) population is a group of individuals, objects or items from which samples are taken for measurement or it is an entire group of persons, or elements that have at least one thing in common. Population is whatever you are counting: there can be a population of people, a population of households, a population of events, institutions, transactions, and so forth. Anything you can count can be a population unit.

Rufiji basin consists of 38 WUAs. Thus, the target population of the study involved all 38 WUAs in the basin where Mkoji catchment was purposively selected from its upstream and downstream. This WUA is composed of leaders and members who manage the catchment area for its sustainability.

3.7 Sample Size and Sampling Strategies

3.7.1 Sample Size

A sample is the portion obtained from a total population (Sekaran, 2003). A sample is a part of the population from which it was drawn. Samples can be drawn in several different ways, such as probability samples, quota samples, purposive samples, and volunteer samples. Sekaran advises that too large a sample size could become a problem and recommended sample sizes between 30 and 500. Similarly, he recommended that a minimum number of samples for research should be 30 (Yin, 2003). Thus, the sample size consisted of (N) 50 participants (i.e., 24 WUAs leaders and 26 WUAs members) from Mkoji catchment area. Based on empirical literature which says that regardless of the population size a sample or sub-sample of 30 cases

is the bare minimum for studies (Bailey, 2004), therefore a sample size of 50 participants were selected as much higher than the empirical recommended minimum sample size.

Table 3.1: Distribution of sample size

Type of respondents	Population	Sample	Percentage %
WUAs leaders	190	24	12.6
WUAs members	456	26	5.7
TOTAL	646	50	

3.7.2 Sampling Strategies

Purposive sampling procedures were used in this study. This involved selecting WUAs leaders and members in Mkoji catchment. These leaders come from specific water user groups such as CBWSOs, Irrigation organization (IO), pastoralists group and fisheries group. based on prioritized water risks. Others come from private sector water users, CBOs and NGOs affecting WR and/or working on water related issues as should they should be nominated as representative in order to be included in the apex WUA.

Also, purposive method was used for the selection of the interviewees and groups for the focus-group discussion. The purposive method was used by focusing on people with good knowledge and understanding about the WUAs and conservation activities; and those possessing key information regarding the influence of WUAs for the environmental, economic and social sustainability of water resources management at Mkoji catchment area in order to attain the study objectives.

3.8 Data Collection Instruments

In-depth interview guide and focus group discussions were used among WUAs leaders and members. In-depth interviews with WUA leaders (as Key Informants) were carried out during the data collection as key informants. This involved 3 leaders from each WUA forming 24 participants for interview. Similarly, focus group discussions (FGDs) were used to collect data from WUAs members (where a group of at least 5 participants was involved in the focus group discussion). Thus, 26 participants were involved in FGDs where at least 5 participants were selected from each selected WUA.

3.9 Reliability and Validity of Instruments

3.9.1 Reliability

Reliability refers to the consistency of a research study or measuring test or the repeatability of findings. If findings from research are replicated consistently, they are reliable (Cresswell, 2009). Mohajan (2017) defines reliability as measure of how consistent the results from a test or measuring instrument are; that is the consistency with which a test measures what it is supposed to measure. It is the ability of the measurements or the degree of which instrument measures the same way each time it is used under the same condition with the same subjects. The researcher used a scientific research methodology in acquisition of data hence no doubt about the results obtained by researcher, whoever used the same procedures would obtain the same or more likely as the researcher (Mohajan, 2017).

In this study pilot study was carried out to test the interview guide in the respective study area for their reliability; afterwards corrections were done, in order to obtain reliable data for the research. This allowed the researcher to study the properties of measurement scales and the items that make them. Since the reliability of data goes with the accuracy or precision of a measuring instrument, in this research study, reliability was concerned with the questions' consistency of responses in repeated measurements (Carmines & Zeller, 2006).

3.9.2 Validity

Validity is defined as the instrument's ability to measure exactly what concept it is supposed to measure (Cresswell, 2009). It also refers to the credibility or believability of the research. In order to validate the data and instruments (interview guide and FGDs) used in the research, the researcher asked the experts to recommend on their representativeness and suitability. Besides, the researcher allowed suggestions to be made to the structure of the questions as argued by Cooper and Schindler (2008). In this study validity of data was ensured by choosing the sample from a true representative of population, preparing a good research tool, having appropriate methods of data collection, pre-testing research instruments and proper recording of data (Mohajan, 2017).

3.10 Trustworthiness of the Study

Trustworthiness refers to the degree to which interpretations and concepts reveal congruent realities between the participants and the research (McMillan and Schumacher, 2001). Trustworthiness in qualitative research is evaluated by four

components namely; credibility, transferability, dependability and confirmability (Lincoln and Guba, 1985). The four components were used as criteria to ensure the rigor of findings in in this study (Anney, 2014).

3.10.1 Credibility

Credibility refers to the confidence that can be placed in the truth of the research findings (Irene and Albine, 2017). However, credibility establishes whether the research findings are plausible information drawn from the participants, original data and is correct interpretation of the participant's original views. The credibility of this study was assured from the truth of the findings by the researcher who provided greater depth and breadth of understanding of the investigated phenomenon. Also, the credibility of this study took place by obtaining data from participants' views, ideas, attitudes, experiences, perceptions and understandings which later were expressed through emanated themes (Ibid).

In this way, the study was enriched with data grounded from different study areas and participants, resulting into authenticity of the findings with greater credibility in the eyes of readers. Moreover, the study used member checks as the crucial process that any qualitative research should undergo because it is a heart of credibility (Lincoln and Guba, 1985). The purpose of doing member check is to eliminate researcher's biasness when analysing and interpreting the results (Anney, 2014).

3.10.2 Dependability

Dependability means the consistent and stability of the research findings over time. According to Gasson (2004) dependability deals with the core issue that is, the way

in which a study is conducted should be consistent across time, researchers and analysis techniques. Miles et al. (2014) insists that, the same research process that generates the same essential findings often depends on external audits (also known as inquiry audits) are an important strategy for feedback, to assess the truthfulness of preliminary findings.

3.10.3 Transferability

Transferability refers to the appropriateness comparison of applying the results to other contexts and settings (McMillan, 2012). Also, transferability involves thick descriptions describing not just the behaviours, but their context as well, so that the behaviours and experiences became meaningful to outsiders (Irene and Albine, 2017). This study ensured transferability by presenting sufficient contextual information of participants' ideas, experiences and perceptions about the influence of WUAs for the sustainability of water resources management at Mkoji catchment area.

3.10.4 Confirmability

Confirmability is the objectivity on how can one establish the extent to which findings of an inquiry are functioning solely by the participants and the condition of inquiry and not of the biases, motivations, experiences, perspectives, attitudes, feelings and interest of the researcher (Moon *et al.*, 2016). The work of findings is the results of experiences and ideas of the participants rather than characteristics and preferences of the researcher (Shenton, 2004). In this study confirmability was ensured by corresponding the data to their original sources, that the researcher sets

aside his potential prejudices, presupposition, biases, opinions and experiences during data process and findings development. The researcher used a bracketing technique so as not to intervene with data provided by participants during interview up to recommendation and conclusion. Therefore, the experiences, views, ideas, recommendations and conclusions were derived from the original data of the participants.

3.11 Data Analysis Procedures

The data from the field were coded and analysed through content analysis as themes and emerging patterns as the researcher coded the interview transcripts. Also, qualitative data from in-depth interviews and FGDs were analysed using content analysis focusing on the observer's impression. Content analysis involved transcribing all information from verbal discussions with informants followed by breaking the recorded information into meaningful smallest units of thematic information, subjects and tendencies and presented as a text.

On the other hand, the qualitative data generated from open-ended questions from KIIs in the interview guide were analyzed and categorized in content and themes in accordance with the research questions and were reported in a narrative form. KIIs were analysed by reducing information into manageable themes, issues and recommendations. Each summarized information about the key informant's position, reason for inclusion in the list of informants, main points made, implications of these observations, and any insights or ideas the interviewer had during the interview were considered and included in the study.

Similarly, the texts read from the documents were skimmed over where the researcher tried to identify key terms and themes, read or reread the text with specific questions in mind. Moreover, data were coded and interpreted in order to seek for both organization and interpretation of data that were subjected into content analysis to provide the meaning of the context.

3.12 Ethical Considerations

All necessary procedures were followed to conform to the ethical standards of research. The researcher sought for the permission from the relevant authorities before carrying out the research. All information obtained in this research were strictly used for academic purposes and respondents were assured of the confidentiality of information given. Moreover, anonymity together with accessibility to research information was observed. Treatment was done according to the organisational protocol for management of data collection. Other issues considered were as follows;

3.12.1 Informed Consent

Participants were given a written statement that explains all the aspects of a study. They were required to formally consent to participate before the commencement of the study by signing the consent form.

3.12.2 Deception

Participants were given the choice of whether they are willing to participate before engaging in the study. The researcher could not mislead or coerce any of the

participants into participating. Such transparency was encouraged to support the participants during the study.

3.12.3 Confidentiality and Anonymity

Information obtained from the participants was held with confidentiality. This ensured that no-one has access to individual information or the names of the participants except the researcher (Cresswell, 2009). In addition, participants were assured that their personal information, including their names and addresses, would not be revealed in any way without their permission.

CHAPTER FOUR

RESULTS AND DISCUSSION OF FINDINGS

4.1 Chapter Overview

This chapter presents the results and discusses the findings. It focuses on presenting the findings as per objectives by exploring the impact of WUAs in facilitating environmental sustainability of water resources management, assessing the impact of WUAs in facilitating economic sustainability of water resources management and examining the impact of WUAs in facilitating social sustainability of water resources management at Mkoji catchment area. It commences with the first objectives as hereunder.

4.2 Impact of WUAs in Facilitating Environmental Sustainability of Water Resources Management at Mkoji Catchment

The first objective explored the impact of WUAs in facilitating environmental sustainability of water resources management at Mkoji catchment area. Participants' views were sought from WUAs leaders and members regarding the matter. The results from in-depth interview and focus group discussions were as follows;

An in-depth interview with the majority of participants showed that there is a broad awareness and understanding of the WUAs purpose as a great number (23/24) of participants agreed on that. Some of the WUAs leaders were able to elaborate as follows;

Leaders understand the responsibilities when WUAs are formed while being provided with knowledge regarding the goals for the formation of WUAs. Their formation has created awareness to the community on how to manage water resources for their economic and environmental sustainability. Leaders also have come to know that water sources are encroached and degraded due to the existence of different human activities; thus, their management needs to be entrusted to the people living around the water's sources (*WUAs leaders*).

Box 4.1: Awareness and understanding of WUA purposes

The statements above concur with Cooper *et al.*, (2008) who reported that WUAs are promoted as key to the rolling out of IWRM principles through a participative process and the evidence shows that catchment systems face enormous and ongoing threats from human activities and thus reducing the quality of life over the coming decades. Thus, if there is no management of such activities, the restoration of catchment areas would be in jeopardy. Also, the opinions from leaders are in agreement with the Guideline for Formation of WUAs (2019) that state that WUAs are essential entities for implementing integrated water resources management development plans. However, the experience from different development partners' (DPs) engagement with WUAs in Tanzania shows that the limited performance of most WUAs hinders the effective management of water resources.

On the other hand, an in-depth interview with the majority of participants showed that there have been little mechanisms for feedback on WUA activities and management. It was stated that;

There is no clear mechanism for feedback and channel for communication to enable good communication between the management of Rufiji basin and WUAs leaders. Also, there has been lack of feedback when WUAs present issues of concerned to the management for assistance and resolutions. In some cases, the feedback may be delayed or not provided altogether. This demoralizes the WUAs participation in the sustainability of the water resources in the catchment areas (*WUAs leaders*).

Box 4.2: WUA activity management

The statements above are in contrary to part VIII, section 80 (I) of the WRM Act No.11 of 2009 that states and encourages feedback provision with regard that WUAs are the institutions and vehicles through which local communities participate in water resources management and governance. The WUA purposes include managing, distributing and conserving water from a source used jointly by members of the association; acquiring and operating permit under the provisions of the Act, resolving conflicts between water users, collecting water user fees on behalf of the basin water board (BWB) and representing special interests such as environment, conservation areas and groundwater. All these must be reported to the basin management, yet in some extent feedback provision has been scanty leading to improper coordination between WUAs and Rufiji basin management.

Moreover, it was reported through an in-depth interview among the majority of participants that WUAs have mechanisms and capacity to resolve conflicts that befall them. This is supported by the legal framework that is Water resources Management Act, and WUA's constitution. This resulted into improving the environment. Some of the participants were of the following view;

Environmental sustainability has been put in place through the application of the Act and WUAs constitution that necessitate the knowledge provision through awareness raising, collaboration with NGO (WWF) to sensitize on water friendly tree plants, improving household water uses by not taking shower within river banks (i.e., 60 meters from the river bank as per EMA &WRMA), not practicing unimproved agricultural activities that leads to water pollution. With such emphasis and control WUAs have to such extent utilized their capacity to manage water resources (*WUAs leaders*).

Box 4.3: WUA Environmental sustainability

Furthermore, an in-depth interview with majority participants with regard to enabling and maintaining water resource infrastructures showed that;

WUAs have a limited skill/knowledge on infrastructure maintenance to water abstracted as the quantity of water allowed to pass through a specific channel to be measured for compliance. Most of the leaders have secondary education that does not enable them understand complex issues such as infrastructure, something that necessitates the assistance from the basin management (*WUAs*

Box 4.4: Enabling and maintaining water resources infrastructures

With regard to the role of WUAs in encouraging the use of climate resilient crops, an interview with majority of participants asserted the following;

Climate resilient crops are encouraged through the application of indigenous knowledge. Although, such knowledge has been used for many years, there is a need to be capacitated with the new climate resilient crops through research and development undertaken to find out updated resilient crops (*WUAs leaders*)

Box 4.5: Use of climate resilient crops

The above affirmation on encouraging resilient crops goes hand in hand with planting trees at the buffer zones as per Environmental Management Act No.20 of 2004. This has been facilitated by WUAs by incorporating indigenous crops such as “mivengi, midobore and mikaratusi maji” that have aided the conservation of the

water sources. The statements above are in line with the basin water board (BWBs) that delegate some of their responsibilities to Water Users Associations as per part IV section 23 (e) (f) (g) and (j). Such responsibilities include, collection of data by water users' members of the water user's association that include monitoring of water flow, water quality, abstraction and discharge points, conservation priorities, climate-change mitigation and adaptation priorities and others, according to the needs of the BWBs and related to the purpose of WUAs stipulated in section 80 (1)

Nonetheless, the focus group discussions for the majority of WUAs participants were of the following views;

There is a broad awareness and understanding of WUAs purpose. Yet, WUAs are unable to trace the non-water sources of pollution coming from solid and liquid waste generated from urban dwellers as they are in most cases formed in rural areas. Yet, WUAs environmental sustainability has been managed with little pace as there have been little assistance in terms of finance to manage the operations entrusted to them (*WUAs Members*)

Box 4.6: Little Assistance on finance

It can be concluded that WUAs are yet environmentally sustainable in most parts of the basin; as a few established faces a number of challenges ranging from inadequate technical and financial capacity to conflicting roles and responsibilities that arise during day-to-day operations.

4.3 Impact of WUAs in facilitating Economic Sustainability of Water Resources Management at Mkoji Catchment

The second objective assessed the impact of WUAs in facilitating economic sustainability of water resources management at Mkoji catchment area. Participants'

views were sought from WUAs leaders and members regarding the matter. The results from focus group discussions and in-depth interview were as follows;

An in-depth interview with the majority of participants regarding the availability of sufficient funds to operate the WUAs, participants were of the following view;

There have been no sufficient funds to manage water resources according to the WUA's formation guideline. WUA members are well defined as any individuals, groups of people and institutions that are either abstracting or diverting water from the sources (surface or ground) for different purposes and have to be allowed by issuance of water use permit as per Water Resources Management Act NO. 11 of 2009 (See s.43) to abstract such amount of water. Source of funds for WUA include entry fee, penalty for defaulters (non-compliant), 20% returns of fee collected from water users) that are within WUA's jurisdiction area. These sources of funds are insufficient and unreliable as when people comply with the regulations, no fines may be collected. Also, entry fees are too little to manage the operations done by WUAs while 20% returns from fees have been little to help WUAs perform their duties with confidence (*WUAs leaders*)

Box 4.7: Insufficient funds

The statements above concur with the Guideline for the Formation of Water User Associations (2019) that stipulates that the importance of WUAs is twofold, firstly they constitute the lower-level institutional architecture of WRM and secondly, they safeguard rights of water users through charging fees as stipulated in the guideline. Through the WUA, the users need to be assured of equitable water allocation. Furthermore, WUAs play a very significant role in resolving water use conflicts and water resource management conservation and protection. Thus, with insufficient funds the management of the water resources has been a challenge.

On the other hand, the in-depth interview with the majority of participants with regard to the opportunities or mechanisms for external support; participants were of the following view;

External support is aligned via tree nursery establishment something that in most cases this support is not demand-driven. It is normally a pilot study support that leaves WUAs with a need to progress without sustainable finance. This results into non-progression of projects that need adequate support from the basin management (*WUAs leaders*)

Box 4.8: Opportunities for external support

The statement above is in line with URT (2002) that state that water is a finite vulnerable resource which is under pressure; and when it is available in adequate quantities and in good quality it becomes a primary input for a whole array of productive activities. Thus, the establishment of trees in buffer zones and the conservation of water resources need to be financed in order to help WUAs have an ample time to manage them.

Furthermore, an in-depth interview with the majority of participants showed that WUAs practice sound accounting and financial transparency as one of the implications as follows.

The practice of sound accounting and financial transparency is done by WUAs by reporting what is collected through fees, penalties etc and presented during meetings as the requirements of their constitution. During the meetings both collection and expenditure are presented for approval or disapproval. The penalties and fines discourage and prevent all economic activities that may be done at the buffer zones of the rivers or near water sources to reduce erosion and siltation (*WUAs leaders*)

Box 4.9: Financial transparency

The FGDs from the majority participants reported that;

Enabling sound accounting and financial transparency is due to the awareness raising campaign, that managed penalty, cost comparison to defects and cost restoration that are not adequately met due to low knowledge and skills possessed by WUAs members and leaders. Moreover, this has been a step towards attaining financial transparency (*FGDs among members*).

Box 4.10: Sound accounting

The statements above are in line with the Operational Guideline for Water Users Association (2019) that asserts that the WUAs have many benefits for the implementation of Integrated Water resources Management such as supporting the basin Water Board to collect/mobilize collection of the water user fees and monitor compliance. Also, supporting the BWB in monitoring of water allocation and quality if they have required skills and capacity; supporting the basin water board in ensuring compliance to protection and conservation of the water resources and aiding WUAs to assist BWBs in the management of monitoring stations from vandalism while representing the interests and increase visibility of the basins' Water Resources Management mandates and responsibilities. All these merges when there is proper coordination among WUAs and the Rufiji basin management

Furthermore, an in-depth interview on the majority of WUAs regarding the role of WUAs to improve economic efficiency of water use, participants were of the following view;

To their level of knowledge, WUAs are only restricted to monitor the calendar for water use where they can impose on penalty administration, but cannot monitor on the quantity of water use due to limited hydrological knowledge on flow and stage/water level measurement that focus on technological devices used to abstracts water (*WUAs leaders*).

Box 4.11: Role of WUAs

Similarly, the FGDs with the majority of participants were of the following view with regard to improving economic efficiency of the water use.

Improving economic efficiency of water use has been obvious through the presentation of quarterly returns via quarterly reporting to the Basin Water Board. WUAs have been reporting what is necessary to the board in order to have an eye on the difficulties they face in managing water resources (*WUAs members*).

Box 4.12: Economic efficiency

The statements above are in line with UN (2008) that insists that competition among different water user groups often leads to conflicts. It usually means that available water goes to the most powerful groups, leaving the poor further marginalized while a little attention is paid to the impact of one group's water use on the availability for others downstream. Also, conflicts arising between users that are not properly managed by WUAs are very common at the local levels especially if intervention of rehabilitated or new construction of irrigation systems take place without taking into consideration the pastoralists and their needs for infrastructure for their livestock.

Additionally, the FGDs from the majority of participants were of the following view with regard to the prevention of economic activities at the buffer zones as they raised a concerned that;

There have been awareness campaigns through leaflets, noticeboards/billboards with message on prohibition of human activities within 60 meters with respect to penalty. This has enabled a great amount of water users to comply to the laws and enable the economic sustainability of water use (*WUAs members*)

Box 4.13: Awareness campaigns

It could be concluded that WUAs have facilitated to a great extent the economic sustainability of water resource management from the fact that what is gained from fees, penalties and fines is utilized for the management of the catchment area. Although, what is obtained has been little, proper utilization and management of funds has been given an upper hand.

4.4 Impact of WUAs in Facilitating Social Sustainability of Water Resources Management at Mkoji Catchment

The last objective examined the impact of WUAs in facilitating social sustainability of water resources management at Mkoji catchment area. Participants' views were sought from WUAs leaders and members regarding the matter. The results from focus group discussions and in-depth interview were as follows;

The FGDs from the majority participants asserted the following views;

To enhance social sustainability of catchment areas has been of great importance to be conserved in order to enable water users participate into their daily activities in an integrated manner. Thus, sufficient and clear incentives for social participation are critical to the success and sustainability of WUAs, perhaps more than any other single factor (*WUAs members*).

Box 4.14: Social sustainability enhancement

On the other hand, an in-depth interview from the majority of participants regarding the need to meet quarterly requirement as per constitution and regulations revealed the following view;

In order to enable social sustainability WUAs do not meet occasionally due to financial constraints. Members of the WUAs are scattered located to about 200 km from one member to another where it becomes difficult to migrate from the far distance to the other. WUAs leaders are in-need of facilitation fare for transport and accommodation to attend the meeting. This becomes difficult to meet their cost as planned in 4 times a year. Thus, sustainability of WUAs is questionable (*WUAs leaders*).

Box 4.15: Constraints to meet occasionally

Nonetheless, with regard to composition of WUAs to attain the social sustainability, the majority of participants were of the following view;

WUAs compose heterogeneous people as per WUAs regulations. The definition of WUA includes domestic water users, irrigation organizations, community-based water supply organizations, environmentalists and pastoralists. This composition enables the thorough sustainability of catchment areas assigned to them and reduces conflicts that arise among them (*WUAs leaders*)

Box 4.16: Composition of WUAs

While enabling the attainment of social sustainability, enforcing rules and regulations, the majority of participants in an in-depth interview were in the following view;

WUAs have the capacity to enforce the rules and regulations as they are trained on WRMA No.11 of 2009 as a tool to support them in enforcing rules and regulations. Moreover, they are guided by the Basin Legal Officer to prosecute some cases that befall in their jurisdiction. A number of cases were reported and defaulters penalized (*WUAs Leaders*)

Box 4.17: Enforcement of rules and regulations

Moreover, FGDs with majority of participants revealed that there has been little support from the LGAs they are found in as follows;

In order to enforce the rules and regulations among WUAs, it was found there is a lack of support from LGAs. This has been vivid from the fact that there are poor linkages between WUA Action Plan to LGAs (*i.e., considering the Organizational Structures for LGA vs Ministry of Water*). It is found that WUAs are at the lower level of Water Resources Management team something that becomes difficult to integrate with Village and Ward Executive Officers who in one way or the other are not aligned to the Organizational Chart, thus supporting when they wish not according to law (*WUAs members*)

Box 4.18: Lack of support from LGAs

The statements above concur with Silas (2014) who reported that the unsuitable design of WUAs has led to a situation in which the authority of the WUA is bypassed. Therefore, in their current form, WUAs are inadequately shaped to undertake the role of monitoring formal water rights. Hence without its local arm, the basin authority has little leverage to control water use throughout the basin.

An in-depth interview to majority participants on WUAs provision of credible assistance to the basin water offices, participants agreed that they provide credible assistance as WUAs are always willing to team up with basin officials to execute and implement water resources activities wherever occurs.

WUAs are eager to draw on traditional resources management approaches when applicable depending on the norms and culture of the vicinity. Those potential/influential leaders within their area of influence are most important for better water resources management. Thus, when consulted, the management of catchment areas becomes simple (*WUAs leaders*)

Box 4.19: Assistance to WUAs

FGDs among the majority participants revealed the following regarding administrative and management ties among players as follows;

WUAs have been able to form administrative and management ties with the basin management and supported socially and administratively for the sustainability of their catchment areas. WUAs are both administratively and hydrologically formed but wherever touches the administrative authority, they must pay for courtesy in every administrative and management for the sustainability of catchment management (*WUAs members*).

Box 4.20: Administrative and management ties

The statements above concur the Operational Guideline for Water Users Association (2019) that states that Water users are individuals or groups or organizations who derive direct benefits from a water source regardless of the purpose of water use. These include the following; those directly using water sources, abstractors, riparian communities, those fetching water for domestic use; those directly affecting water sources, users discharging into the water sources (with or without permit) and riparian communities who live close or have activities along the buffer zone even if they are not directly using water. These help in their day to day administrative and hydrological management for the sustainability of the water resources.

Furthermore, the FGDs with the majority of participants revealed that;

WUAs have been encouraging afforestation and reforestation for labor sequestration in all identified degraded areas and where tree species for restoration need to be managed. It was found that afforestation and restoration of trees has been done with some support from the basin. This has enabled a queer environment that has ties with the society (*FGDs members*).

Box 4.21: Restoration of environment

In order to socially sustain well the catchment areas WUA members that include water users and other stakeholders may not necessarily be using water but rather the like-minded stakeholder groups or organizations with interest in WRM (see section 3.1.2 for example of different roles of water users and stakeholders). These include: a) Environmental Conservation groups (CBOs and NGOs); b) All groups related to water and environment (including water supply and sanitation stakeholders, CBWOS, utilities etc.) and c) District environmental officer, District water officer, village environmental committees and village water committees. Although these are not well attached into an organisation structure, their proper incorporation is important in order to alleviate the challenges that emanate from their detachment.

All in all, the impact for WUAs in facilitating social sustainability of water resource management has been earmarked from the fact that the society in one way or the other has been incorporated in various activities such as participating in meetings with heterogeneous groups, afforestation and restoration of trees and other species something that deter soil erosion and siltation.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

WUA have many influencing benefits for the sustainability of water resources management at Mkoji catchment in Rufiji basin. They have enhanced the support for the Basin Water Board to collect/mobilize collection of the water user fees and monitor compliance; support the BWB in monitoring of water allocation and quality if they enhanced with required skills and capacity; support basin water board in ensuring compliance to protection and conservation of the water resources; assist BWBs in the management of monitoring stations from vandalism and represent the interests and increase visibility of the basins' Water Resources Management mandates and responsibilities.

Moreover, it is concluded that WUAs are yet to be environmentally sustainable in most parts of the basin; as a few have been established while facing a number of challenges ranging from inadequate technical and financial capacity to conflicting roles and responsibilities. Similarly, WUAs have facilitated to a great extent the economic sustainability of water resource management at Mkoji catchment area from the fact that what is gained from fees, penalties and fines is utilized for the management of the catchment area although it is not sufficient to accommodate the running costs for motorcycles, office space and meeting allowance of leaders and members. Likewise, it was found that the Basin Water Board is not fully supporting WUAs in terms of finance due to un-realistic estimates of water users (as water user

fees are not timely collected due to both ability and willingness to pay among users). Although, what is obtained has been little, proper utilization and management of funds has been given an upper hand. Finally, WUAs in facilitating social sustainability of water resource management has been earmarked from the fact that the society in one way or the other has been incorporated in various activities such as participating in meetings with heterogeneous groups, maintain afforestation and restoration of trees and other species something that discourage soil erosion and siltation. Moreover, unsuitable design of WUAs has led to a situation in which the authority of the WUA is bypassed. Therefore, in their current form, WUAs are inadequately shaped to undertake the role of monitoring formal water use permits. For example, BWB does not communicate formally with WUA as no communication mechanism/policy can be tracked, and there is no proper feedback regarding reporting activities that seems to be accompanied with little or no acknowledgement of their works. Hence without its local arm, the basin authority has little leverage to control water use throughout the basin.

5.2 Recommendations

The subsequent recommendations are put forward based on conclusion as follows;

i) To enhance the environmental sustainability of water resources management, the organisation structure for the formation of WUAs is required to be properly linked to the Ministry of Water via LGAs where the WUAs are positioned to enable formal reporting and collaboration (e.g., the department of environment in LGAs is not linked with WUAs).

ii) To enhance the economic sustainability of water resources management, WUA leaders and members need to be capacitated with knowledge to enable them measure both quantity and quality parameters to enable users comply with permit conditions thereby collecting fees and penalties with transparency. This can be managed through entering into memorandum of understanding (MoU) between BWB and WUAs on fee collection and 20% returns.

iii) To enhance social sustainability of water resources management, the Ministry of Water should establish a communication policy/mechanism that may trace the stakeholders for better communication between BWB and WUA. Also, enhance LGAs Organizational Structure to accommodate WUAs Action Plan.

5.3 Policy Implications

To Policy Makers: Setting up queer WUA policies, bylaws, contracts, trainings and M&E are important means to improve the performance of WUAs.

To the Industry: Enabling WUA framework to facilitate the environmental, economic and social sustainability of water resources management is important.

To the Academia: Carrying studies for the enhancement and adaptation of management roles among WUAs is important in order to deliver transformative services and improve rural livelihoods.

5.4 Further Studies

The study investigated the influence of WUAs for the sustainability of water resources management with reference to Mkoji catchment in Rufiji basin. It is advised that further studies be done on the role played by WUAs in restoring tree species found in the Rufiji basin.

REFERENCES

- Ahmad, M. & Haie, N. (2018). Assessing the impacts of population growth and climate change on performance of water use systems and water allocation in Kano River basin, Nigeria. *Water* 10(12):1–21
- Anney, V. N. (2014). Ensuring the qualitative of the findings of qualitative research looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies*: 5(2): 272-281.
- Bastian, O.; Grunewald, K. & Syrbe, R.-U. (2015). Terrestrial Ecosystem Services in River Basins: An Overview and an Assessment Framework. *In Ecosystem Services and River Basin Ecohydrology*, pp. 107–132. Dordrecht, The Netherlands: Springer Netherlands.
- Busch, M.; La Notte, A.; Laporte, V. & Erhard, M. (2012). Potentials of quantitative and qualitative approaches to assessing ecosystem services. *Ecol. Indic*, 21: 89–103.
- Butler, C., a& Adamowski, J. (2015). Empowering marginalized communities in water resources management: addressing inequitable practices in participatory model building. *Journal of Environmental Management* 153:153–162
- Chepyegon, C.; & Kamiya, D. (2018). Challenges faced by the Kenya water sector management in improving water supply coverage. *J. Water Resources. Prot.* 10: 85–105.
- Cooper, A. & Schindler, M. (2008). *Perfect Sample Size in Research*. New Jersey, USA: Macmillan.
- Cooper, P.J.M.; Dimes, J.; Rao, K.P.C.; Shapiro, B.; Shiferaw, B. & Twomlow, S. (2008). Coping better with current climatic variability in the rain-fed farming

systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agric. Ecosyst. Environ*, 126: 24–35.

Cresswell, P (2009). *Research Methodology Methods & Techniques, Second Edition*, New Delhi, India: New Age International publisher

Derman, B. & Prabhakaran, P. (2016). Reflections on the formulation and implementation of IWRM in Southern Africa from a gender perspective. *Water Altern*, 9: 644–661.

Dyer, F.; ElSawah, S.; Croke, B.; Griffiths, R.; Harrison, E.; Lucena-Moya, L.P.; Jakeman, A. (2014). The effects of climate change on ecologically relevant flow regime and water quality attributes. *Stoch. Environ. Res. Risk Assess*, 28: 67–82.

Greene, E, Dockel, J. & Ligthelm, A (2010). *Research Perspectives*. London, UK: Thomson

Haie, N. (2021). *Transparent Water Management Theory. Water Resources Development and Management*. Gateway East, Singapore: Springer Singapore.

IUCN, (2010). *The Wami Basin Situation. Eastern and Southern Africa programme analysis*. Nairobi, Kenya: ESARO Publications.

Komakech, H. C., & P. van der Zaag. (2011). Polycentrism and pitfalls: the formation of water users' forums in the Kikuletwa catchment, Tanzania. *Water International* 38:231–249

Mbuya, L. W. (2004). *The Hydrology Ecosystem Conservation and Management in Tanzania and Vision*. The Hydrology of Mara River Basin. Management Initiative Consultancy Tanzania Programme office. Mara, Tanzania.

- McMillan, J. H. (2012). *Educational research for consumer*, 6th Ed. New York, USA: Pearson Education.
- Ministry of Water and Livestock Development (2009). Water Resource Management Act of 2009; Ministry of Water and Livestock Development: Dar es Salaam, Tanzania.
- Mohajan, H. K. (2017). Two criteria for good measurements in research: Validity and reliability. *Annals of Spiru Haret University. Economic Series*, 17(4): 59-82
- Moon, K., Brewer, T. D., Januchowski-Hartley, S. R., Adams, V. M., & Blackman, D. A. (2016). A guideline to improve qualitative social science. *Journal of Ecology and Society*, 21(3): 1-20.
- Muyungi, R. S. (2007). Managing Land Use, Protecting Land and Mitigating Land Degradation: Tanzania Case Study. In: Sivakumar M.V.K., Ndiang'ui N. (eds) *Climate and Land Degradation. Environmental Science and Engineering (Environmental Science)*. Heidelberg, Berlin: Springer.
- Ndelwa, L. L. (2014). Role of Water User Associations in the Management of Water Use Conflicts: A Case of Ilonga Sub-Catchment in Wami/Ruvu Basin, Tanzania. Master's Thesis, Sokoine University of Agriculture. Morogoro, Tanzania.
- Noel, S. (2011). The Economies of Climate Change in Tanzania, Water Resources. Stockholm. Environmental Institute SEI-Africa Centre Institute of Resource Assessment, University of Dar es Salaam. Available online: http://economics-of-cc-in-tanzania.org/images/Water_resources_final_.pdf (accessed on 12 April 2021).

- Overton, I. C., Smith, D. M., Dalton, J., Barchiesi, S., Acreman, M. C., Stromberg, J. C. & Kirby, J. M. (2014). Implementing environmental flows in integrated water resources management and the ecosystem approach. *Hydrol. Sci. J*, 59: 860 - 877.
- Silas, S. R. (2014). Reducing Impact of Land Degradation in Tanzania: Do Incentive Market Based Mechanisms Work for Sustainable Land Management? *Journal of Sustainable Development*, 7(6): 1-7.
- Subramanian, A. N., Jagannathan, V. & Meinzen-Dick, R. (1997). User organizations for sustainable water services. World Bank, Washington, D.C. Available at <https://doi.org/10.1596/0-8213-3855-2>. (Accessed on 2nd May, 2019).
- URT, (2002). National Water Policy, Ministry of Water and Livestock Development. Dar es Salaam, Tanzania.
- World Bank (2019). Water Stress Could Hurt Tanzania's Growth and Poverty Reduction Efforts—New. World Bank Report Available online at <https://www.worldbank.org/en/news/press-release/2017/11/06/water-stress-could-hurt-tanzanias-growth-and-poverty-reduction-efforts---new-world-bank-report>. (Accessed on 2nd April 2021).
- WWF Tanzania Country Office (WWF-TCO). (2010). Assessing Environmental Flow Assessment. The Great Ruaha River and Ihefu Wetlands, Tanzania, and Options for the Restoration of Dry Season Flows. Dar es Salaam, Tanzania.
- Zimmerman, N. L. (2010). Ecological responses to altered flow regimes: A literature review to inform the science and management of environmental flows. Environmental Flows. *Sci. Manag*, 55: 194-205.

APPENDICES

Appendix 1: Interview Guide Questions for WUAs Leaders

A. Environmental sustainability

- i) Is there broad awareness and understanding of the WUA's purpose?
Yes () No ()
- ii) If Yes, elaborate
- iii) Are there mechanisms for feedback on WUA activities and management?
Yes () No ()
- iv) If Yes, elaborate
- v) Do WUAs have mechanisms and capacity for conflict management?
Yes () No ()
- vi) If Yes, elaborate
- vii) Do WUAs improve environmental sustainability? Yes () No ()
- viii) If Yes, elaborate
- ix) Does the WUAs enable the maintenance of infrastructures? Yes () No ()
- x) Do WUAs encourage the use of climate resilient crops? Yes () No ()
- xi) If Yes, elaborate
- xii) Do WUAs plant trees at the buffer zones (protected areas) according to Environmental Act of 2004? Yes () No ()
- xiii) If Yes, elaborate

B. Economic sustainability

- i) Does the WUA have sufficient funds to operate? Yes () No ()
- ii) If Yes, elaborate

- iii) If No, elaborate
- iv) Are there opportunities or mechanisms for external support? Yes () No ()
- v) If Yes, elaborate
- vi) Does the WUAs practice sound accounting and financial transparency? Yes ()
No()
- vii) If Yes, elaborate
- viii) Do WUAs enhance the prevention of all economic activities at the buffer zones
of the rivers or near water sources to reduce erosion and siltation?
Yes () No ()
- ix) If Yes, elaborate
- x) Do WUAs improve economic efficiency of water use? Yes () No ()
- xi) If Yes, elaborate

C. Social sustainability

- i) Do WUAs meet regularly? Yes () No ()
- ii) If Yes, elaborate
- iii) Does the WUA comprise a heterogeneous group? Yes () No ()
- iv) If Yes, elaborate
- v) If No, elaborate
- vi) Are WUA leaders able to enforce rules and regulations? Yes () No ()
- vii) If Yes, elaborate
- viii) If No, elaborate
- ix) Do WUAs provide credible assistance to Basin Water Offices? Yes () No ()
- x) If Yes, elaborate

- xi) Are there possibilities to draw on traditional resource management approaches when applicable? Yes () No ()
- xii) If Yes, elaborate
- xiii) Do the WUAs follow the administrative and management ties while being supported socially and administratively for the sustainability of their catchment areas? Yes () No ()
- xiv) If Yes, elaborate
- xv) If No, elaborate
- xvi) Do WUAs encourage afforestation and reforestation for carbon sequestration? Yes () No ()
- xvii) If Yes, elaborate
- xviii) If No, elaborate

Appendix 2: Focus Discussion Groups for WUAs members**A. Environmental sustainability**

- i) Is there broad awareness and understanding of the WUA's purpose?
Yes () No ()
- ii) If Yes, elaborate
- iii) Are there mechanisms for feedback on WUA activities and management?
Yes () No ()
- iv) If Yes, elaborate
- v) Do WUAs have mechanisms and capacity for conflict management?
Yes () No ()
- vi) If Yes, elaborate
- vii) Do WUAs improve environmental sustainability? Yes () No ()
- viii) If Yes, elaborate
- ix) Does the WUAs enable the maintenance of infrastructures? Yes () No ()
- x) Do WUAs encourage the use of climate resilient crops? Yes () No ()
- xi) If Yes, elaborate
- xii) Do WUAs plant trees at the buffer zones (protected areas) according to Environmental Act of 2004? Yes () No ()
- xiii) If Yes, elaborate

B. Economic sustainability

- i) Does the WUA have sufficient funds to operate? Yes () No ()
- ii) If Yes, elaborate
- iii) If No, elaborate

- iv) Are there opportunities or mechanisms for external support? Yes () No ()
- v) If Yes, elaborate
- vi) Does the WUA practice sound accounting and financial transparency?
Yes () No ()
- vii) If Yes, elaborate
- viii) Do WUAs enhance the prevention of all economic activities at the buffer zones
of the rivers or near water sources to reduce erosion and siltation?
Yes () No ()
- ix) If Yes, elaborate
- x) Do WUAs improve economic efficiency of water use? Yes () No ()
- xi) If Yes, elaborate

C. Social sustainability

- i) Do WUAs meet regularly? Yes () No ()
- ii) If Yes, elaborate
- iii) Does the WUA comprise a heterogeneous group? Yes () No ()
- iv) If Yes, elaborate
- v) If No, elaborate
- vi) Are WUA leaders able to enforce rules and regulations? Yes () No ()
- vii) If Yes, elaborate
- viii) Do WUAs provide credible assistance to Basin Water Offices?
Yes () No ()
- ix) If Yes, elaborate

- x) Are there possibilities to draw on traditional resource management approaches when applicable? Yes () No ()
- xi) If Yes, elaborate
- xii) Do WUAs encourage afforestation and reforestation for labour sequestration? Yes () No ()
- xiii) If Yes, elaborate

Appendix 3: Work plan

Activity	Duration in Months of 2021											
	J	F	M	A	M	J	J	A	S	O	N	
Preparation of Research Proposal, Questionnaire and Submission of Research Proposal	■											
Pilot study and Questionnaire testing												
Field work and Data collection					■							
Data Processing and Analysis						■						
Dissertation writing and Submission						■						