

**INSTITUTIONAL FACTORS THAT INFLUENCE THE SURVIVAL OF
TRADITIONAL IRRIGATION SCHEMES IN NYANDIRA, MVOMERO
DISTRICT, MOROGORO-TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN RURAL
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ABSTRACT

Many studies on irrigation institutions in Tanzania have not focused on the survival of the traditional irrigation schemes. Therefore this study aimed to fill that knowledge gap. The main objective of this study was to assess institutional factors that influence the survival of traditional irrigation schemes in Nyandira Ward-Mvomero District, in Morogoro Tanzania. Specific objectives were determination of the institutional factors that influenced traditional irrigation schemes in Nyandira, examination of the gender relations among actors in traditional irrigation schemes, determination of the attitude of irrigators towards water permit systems and operationalization of the survival status of traditional irrigation schemes. The study adopted a cross-sectional research design and data were collected from a sample of 200 respondents through household questionnaire survey. Additionally, Focus Group Discussions and key informant interview methods were also used to collect the data. Multistage, purposive and simple random sampling methods were used. Qualitative data were analysed using content analysis and quantitative data by SPSS. Descriptive and inferential statistics were used in analysing the data. The results show that enforcement on water payment fees ($\beta = +0.796$), water committee ($\beta = +0.159$) and users conformity to rules and regulations ($\beta = +0.060$) are statistically significant at $p < 0.001$ while rules on water distribution ($\beta = +0.0125$) and land ownership ($\beta = +0.096$) are statistically significant at $p < 0.01$. Gender relations are similar on access to (95%) and control (94%) over resources. Furthermore, 57% of respondents had a positive attitude towards water permits and survival of traditional schemes. Based on these results it is concluded that institutional factors have a significant influence on the survival of traditional irrigation schemes. It is recommended that WUAs should be registered and apply for water permits to get public funds. This will strengthen the survival of traditional irrigation schemes in Tanzania.

DECLARATION

I, Kulwa, J. Shimiya, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

Kulwa. J. Shimiya
(MARD - Candidate)

Date

The above declaration is confirmed by

Prof. Andrew K.P.R Tarimo
(Supervisor)

Date

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LIST OF ABBREVIATIONS AND SYMBOLS

DAELP	Department of Agricultural Engineering and Land Use Plan
DSI	Development Studies Institute
FGD	Focus Group Discussion
IWRM	Integrated Water Resources Management
LRS	Likert Rating Scale
MARD	Master of Arts in Rural Development
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania (<i>Tanzania Farmers Network Association</i>)
NIA	National Irrigation Administration
NSGRP	National Strategies for Growth and Reduction of Poverty
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TDHS	Tanzania Demographic and Health Survey
Tshs	Tanzanian Shillings
UMADEP	Uluguru Mountain Agricultural Development Project
UNFPA	United Nations Population Fund
URT	United Republic of Tanzania
USAID	United States Agency for International Development
VIF	Variance Inflation Factor
WUA	Water User Associations

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Institutions can be understood as entities defined by a configuration of legal, policy and organisational rules, conventions and practices that are structurally linked and operationally embedded within a well specified environment (Cossio and Callejo, 2009). They consist of informal constraints such as sanctions, taboos, customs, traditions, and codes of conduct and formal constraints such as constitutions, laws and property rights (North, 1991). Institutions enable irrigators to identify problems and opportunities associated with their systems (Hodgson, 2006). It is argued that irrigation institutions enable rehabilitation of traditional smallholder schemes and manage water resources that can contribute to poverty reduction and food security (Tafesse, 2003). Rules are meant to constrain the socially undesirable behaviour in the distribution, use of water and applying mechanism that monitors water delivery (Bandaragoda, 2000). According to Tanzania context, a traditional irrigation scheme comprises of permanent infrastructure and/or facilities that are technically constructed/installed and owned by farmers.

Irrigated agriculture is an essential component of any strategy to increase global food supply. The benefits of irrigation have resulted in lower food prices, higher employment and a more rapid agricultural and economic development (Chazovachii, 2012).

Africa has promoted small scale irrigated agriculture as a means of ensuring food security as well as improving the standard of living of the rural people. Despite their important role in improving livelihoods of rural farmers, small scale irrigation have had limited performance as well as low survival status (Mwendera and Chilonga, 2013). Research undertaken by the Water Commission has identified 317 small-scale irrigation schemes

covering approximately 50 000 hectares in South Africa have collapsed while many of irrigation schemes are under performance. This experience is not limited to South Africa but it appears to be a challenge facing the majority of African countries (Thomas, 2010).

Many studies, particularly in Sub-Saharan Africa, have reported that majority of the farmers are women and their substantial contributions is highly acknowledged. Therefore, in order to keep them motivated there should be an equality between all genders in term of participation, decision making, governing and representation in any agricultural activities as far as male of all ages are given chances (Obuobie *et al.*, 2004).

Sub-Saharan Africa as a whole still lags behind most regions in the world when it comes to water access, management and supply (McClain, 2012). The region has very arid conditions in the south-centre and south west of the continent, and is subjected to high climatic variability and highly unreliable rainfall regime which worsens the region's vulnerability to recurring droughts (Msangi, 2014). For example the Gezira irrigation scheme in Sudan, which is one of the largest irrigation scheme in Africa had an institutional set up at every stage of its development. However, involvement of to be irrigators was minimum due to top down approach. Lack of irrigators association coupled with poor funding and limited technical staff has led to poor performance of smallholder irrigation schemes in sub-Saharan Africa (Fadul and Red, 2010).

Due to these challenges, the Tanzania Government decided that water affairs should be under control of the Ministry of Water. The regulatory and institutional framework for sustainable development and management of water resources is provided in the Water Resources Management Act no. 11 of 2009. The Act outlines principles for water resources management, provides for the prevention, utilization, distribution, control of water

pollution, participation of stakeholders and irrigators associations in implementation of National Water Policy of 2002 (Kashaigili, 2010).

In Morogoro Region, the Ministry of water is implementing that policy through Wami/Ruvu River Basin Office. In that respect, all water user associations are supposed to be registered by the Basin Administration so as to get funds for operation and maintenance of their canals (JICA, 2013). At Nyandira village in Mvomero District in Morogoro Region, traditional irrigation schemes were established in 1920s as a supplement for rainfed crop production. The overall objectives were to ensure household food security, improve farmer's income and alleviate poverty through an increase in agricultural production and productivity resulting from access to irrigation water (URT, 2010).

In Nyandira Ward in Mvomero District, smallholder farmers who own, control and manage their irrigation ditches traditionally have permanent water sources. They grow traditional food crops during the rain season such as maize, sunflower and beans followed by mixed crop production during irrigation season such as cabbage, carrot, tomatoes and potatoes, paprika, salad and fruits. The sources of water are managed through irrigator's associations (Banzi, personal communication, 2013). The main functions of these associations are construction, management, distribution and conservation of water for irrigation and other domestic uses such as bricks making, cooking, feeding animals, resolution of conflicts and collection of water charges for operation and maintenance. Nevertheless, other traditional irrigation schemes in Nyandira have survived while others have not (Chamlungu, personal communication, 2012). The reasons for that variation have not been empirically revealed. The aim of this study was to assess institutional factors that have influenced the survival of traditional irrigation schemes in Nyandira Ward-Mvomero District.

The survival of traditional irrigation sector in Tanzania from the 1960s to the 1980s in developmental and operational context is reported with inadequate achievement. The rate of development of new irrigation systems began to pick up from 1980s with the start of several other irrigation scheme development projects through external support. Despite the increased activities, the survival of these schemes were minimal (Mwandosya, 2008).

Tanzania Government started promoting strong water users participation in the river basin water boards, which are under the Government since early 1990s. It also initiated the establishment of Water User Associations (WUA) at the lowest tiers, which were expected to manage irrigation and other water use institutions for multiple uses at Village and Ward (Van Koppen *et al.*, 2004a).

Mvomero District is among the areas in the country which is faced with survival problem of its traditional irrigation schemes because most of canals are being operated and maintained by indigenous who are having financial constraint (URT, 2010). The extent to which the problem persists has not been empirically proved. The question why traditional irrigation schemes have failed to survive in the District, despite efforts by the Government, through River basin, Ward and Village offices in establishing institutions to ensure governance of WUAs at local level is debatable. It may be due to weak institutions under local Government; inappropriate system design; ineffective management; low irrigation efficiencies; poor operations and maintenance or other factors. However, it is not known empirically whether any of these reasons have caused the variation of the survival status of the traditional irrigation schemes in the District. Therefore, there was a need for an investigation on irrigation institutions and survival of traditional irrigation schemes.

1.3 Justification

Many studies on irrigation institutions in Tanzania have focused on the performance of river basins. Little attention has been given to the survival of traditional irrigation schemes in relation to institutions. Therefore, this study aimed to fill this knowledge gap.

Studies on irrigation institutions are vast, but very few have been conducted in Tanzania. Studies done by Igbadun *et al.* (2007), van Koppen *et al.* (2004a), Komakech *et al.* (2011a) and Sokile *et al.* (2005) centred on irrigation scheduling, formal water rights, management of river basin and integrated water resources management between formal and informal institutions respectively. In this respect very little is known on the attribute of institutional factors towards the survival of traditional irrigation schemes. Therefore, the purpose of this study was to fill this knowledge gap.

This study operationalized the survival status in the study area and determined the attitude of irrigators towards the water permit systems. This has opened the door for policy makers and planners to advocate water permit systems and strengthen the survival of traditional irrigation schemes during the planning and implementation of water development projects (Deribe, 2008). This study is in line with irrigation and drainage policy of 2010, which is focusing on addressing water management and survival of irrigation schemes in Tanzania.

1.4 Objectives of the Study

1.4.1 Main Objective

The main objective of the study was to assess institutional factors that influenced the survival of traditional irrigation schemes in Nyandira, Mvomero District, Morogoro-Tanzania.

1.4.2 Specific Objectives

The specific objectives were to:

- i. Determine the institutional factors that govern the traditional irrigation schemes in Nyandira.
- ii. Examine gender relations among actors in traditional irrigation schemes.
- iii. Determine the attitude of irrigators towards water permit systems
- iv. Operationalize the survival status of traditional irrigation schemes in Nyandira.

1.5 Research Questions

- i. What institutional factors govern traditional irrigation schemes in Nyandira?
- ii. How do gender relations affect the actors in traditional irrigation schemes?
- iii. Do irrigators view negatively or positively on water permit systems?
- iv. What is the current survival status of traditional irrigation schemes in Nyandira?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Concepts

2.1.1 Institutions

Kristen *et al.* 2009 argue that, identifying institutions and their attributes is not an easy task. Institutions are invisible: there are multiple definitions of institutions, there are multiple interactions among them, and they operate at multiple levels and are inter-nested. Institutions also perform a variety of social and economic functions, and they connect and affect different sets of actors. To identify institutions that have significant influence in the action domain, and the attributes that make them significant, can be considered by addressing questions about what institutions are, who they connect and affect, why they exist and how do they work. To understand and define institutions it is also important to distinguish between “institutions” and “organizations,” although these terms are often used interchangeably in everyday language. In the context of institutional analysis, however, institutions are complex in terms of norms and behaviours that persist over time by serving some collectively, whereas organizations are structures of recognized and accepted roles, formal or informal (Kristen *et al.*, 2009).

Institutions are defined as the rule of law (both customary and legal) that are essential for the creation of human-made assets and the efficient operation of property rights. Strong institutions can pick up signals, balance interests, and execute policies through credible commitments to ensure long-term sustainability while weak institutions are those that are not committed enough to govern certain activity (World Bank, 2003). Institution is simply a set of rules actually used by a set of individuals to organize repetitive activities that

produce outcomes affecting them and potentially affecting others. Hence an irrigation institution is a set of rules for water distribution and using water in a particular location (Ostrom, 1992). Irrigation institutions are defined as collective arrangements at scheme level for water control and use, which include water distribution, construction of infrastructure, and rehabilitation. Institutions have a great role in the survival of traditional irrigation systems, as they are key to efficient and equitable distribution of irrigation water to beneficiaries, canal construction and maintenance. They contribute to increase in productivity, effective internal governance and ensure the participation of women (Deribe, 2008). According to this study, institutions are the rules, regulations, sanctions, governance, laws and policies that are guiding traditional irrigation schemes in Nyandira so as to ensure their survival.

2.1.2 Gender Relations

Gender relations are the ways in which a society defines rights, responsibilities and the identities of men, women, boys, girls and elders in relation to one another (Al-Naber and Shatanawi, 2004). In most of the Tanzania's patriarchy societies, men largely control the sale of crops and animals and use of the income although women make substantial contributions to agricultural production and household well-being. The failure to value their work limits women's bargaining power in economic transactions, the allocation of household resources, and wider community decision-making (Macha and Mdoe, 2002).

2.1.3 Water Permits

Water permits refer to licences, water rights and concessions, which are similar to legal tools. Under these regimes, most or all of the nation's waters are declared public waters and thereby vested in the state as custodian or public trustee. From that, citizens can obtain lawful access to water either by applying for administrative permits or by being formally

exempted from such obligations (van Koppen *et al.*, 2014). Water rights/permit is defined as the process of establishing recognized claims to water of certain quantity and quality on a particular site at certain timings. Making investments in the physical infrastructure to abstract, store, and/or convey water and thus, create such use value of water in terms of quantity, quality, site and timing, is the single most important ground for vesting claims to water (van Koppen and van der Zaag, 2010).

2.1.4 Rehabilitation

Rehabilitation is defined as restoration of physical structure to original specification in which case it is also viewed as an extended maintenance activity which takes place periodically and involves high costs than routine maintenance (Mwendera and Chilonda, 2013). According to Wotie and Hanaraj, 2013 a government should be responsible to undertake major maintenance or rehabilitation works which could be beyond the capacity of the Water User Associations in providing technical assistance on the irrigation management as a whole.

2.1.5 Survival

Survival refers to the state or fact of continuing to exist from an earlier time especially when similar things have disappeared (Longman, 2003). According to this study in Nyandira-Uluguru Mountains, survival means the persistence of traditional irrigation schemes which have been in existence since 1920s. According to Omid *et al.*, 2012, irrigation management made by WUAs especially in operation and maintenance of traditional irrigation schemes is imperative in making them sustainable.

2.2 Theoretical Framework

Structural Functionalism Theory by Emile Durkheim (1858-1917) proposes that a human society is like an organism and is made up of a structure called social institutions. These institutions are specially structured so that they perform different functions on behalf of the society. This theory attempts to provide an explanation on how human society is organized and what each of the various social institutions does in order for the society to continue existing. According to this theory, as a result of being interrelated and interdependent, one organ can affect others and ultimately the whole society. The society can also affect one or all social institutions (Kombo and Tromp, 2006).

In this study it was found to be necessary to adopt the concept of Structural Functionalism theory of Emile Durkheim 1858-1917 (Kombo and Tromp, 2006) so as to conceptualize the significant implication of the roles played by institutions such as rules, regulations, customary laws, governance, policies and taboos to the survival of traditional irrigation schemes in Nyandira. A fascinating question is: Do the institutions which have governed Water User Associations in Nyandira have any significant influence to the survival of the traditional irrigation schemes?

2.3 Empirical Review

According to a study done in Tanzania by Lein and Tagseth (2009), irrigators' associations are sharing a scheme or a source of water. Although there are wide variations in actual institutional set-up and practices in such associations, it can be argued that they share some common traits. The members of the community have the right to utilise the resource, but there are minimum number of individuals who are members of the water user associations. Rights in these commons are embedded in a system of reciprocal rights and obligations. In order to access water, one has to fulfil certain obligations (e.g. being a member of the

irrigators association, contributes to the construction or rehabilitation of infrastructure). Once these obligations are fulfilled, a person has a right to water along with other irrigators.

A study done by Lauraya and Sala (1995) in the Philippines showed that traditional irrigation systems are managed by smallholder farmers who work under irrigators association with the influence of the National Irrigation Administration (NIA). The NIA began its participatory program in the traditional irrigation systems in 1976, and have survived to date, and this is due to its positive results to the beneficiaries. The National Irrigation Association has enabled to transform national irrigation systems into jointly traditional farmer-managed irrigation systems with the ultimate aim of completely transferring operation and maintenance (O&M) responsibilities to the irrigators associations. Deribe (2008), reported that the involvement of smallholder farmers in the management of traditional irrigation schemes through irrigators' association can accelerate the improvement in the overall systems performance because they will learn and practice about preservation awareness, gender equality, maintenance of water sources, security of canal, conservation of natural vegetation along the canal and fair distribution of water between upstream and downstream users and conflict resolutions.

Infrastructure is an essential component of irrigation schemes. It is through them that water is collected and conveyed to the crops or farms. The level and sophistication of irrigation infrastructure determine how much water can be collected and maintained over time. Rehabilitation of these facilities constitutes an essential aspect of the community irrigation scheme management process, and the survival of the scheme. Akudugu (2007) reported that the irrigators' association has been able to rehabilitate the irrigation infrastructure with the use of local tools and knowledge which lead their survival.

The ‘official guards’ of traditional irrigation schemes are the farmers themselves who ‘rotates’ on a regular basis (Lam, 1998). The rehabilitation of the canal is the main duty that all users of the canal ought to perform. However, it depends on the relative importance of the irrigated farming to the livelihood strategies and to the physical position of the field along the canal. In practice, both upstream and downstream users should undertake maintenance. Bolding *et al.* (2010) observed that survival of traditional irrigation schemes is a result of the irrigators’ efforts towards payment of membership fee, security and rehabilitation of the canals.

Assessing the gender relations among actors on the basis of their productive identities, decision making, giving orders, collecting membership fees, keep money, dig a new canal, expand canal, design plan and to accept new members in the irrigators’ association can provide a picture of how gendered society attributes to the team work in traditional irrigation schemes in Tanzania (Lecoutere, 2010).

Institutions enable to govern irrigators’ associations so as to ensure sustainable exploitation of water resources. Masanyiwa *et al.* (2013) reported that, any strong institution is obliged to consider gender equality in irrigation activities so as to determine who has access to and control over water resources so as to include all beneficiaries of all ages and sexes. Gender relations are of central importance for processes in which people's practices make and remake the ‘rules of the game’ because it plays a role in compliance to the rules, norms and agreements about water use. Therefore, survival of a particular traditional canal largely depends on the effectiveness of the institutions in monitoring gender equality and fairness in division of labour so as to regulate the use of the water resources equally (Akudugu, 2013).

Women in developing countries are widely recognized to be in the frontline when it comes to farming activities, especially among smallholders. Research on gender and agriculture in Tanzania indicates that traditional gender roles in agriculture are changing, although causes for such changes are different and location specific thus difficult to generalize. A review of literature suggest that the existing gender inequality in agricultural production affects economic development and benefits especially for women (Jeckoniah *et al.*, 2013). In that case, gender relations should be addressed in order to ensure equality in access to and control over resources as well as farm and irrigation activities so as to ensure participation of both genders that could draw attention over rehabilitation of the traditional canal in order for it to survive.

Water for irrigation in Tanzania is managed via the issuance of formal water rights ('permits') to water users against the payment of an annual fee that are expressed in quantitative flow units. Associated with this is the registering of users and establishment of water user associations as legal entities. Therefore, having formal water rights are the key means for achieving government's assistance (World Bank, 1996). However, law makers to date have not recognised the role that customary agreements play at the local level. Therefore, they do not give it a room in the new legislation. Research by van Koppen *et al.*, 2004b supports the view that customary rights have not been fully recognised at the local level.

In Tanzania all water users or WUA are obliged to register with the Ministry of Water to obtain a water permit so as to obtain grants for operation and maintenance of their canals (van Koppen *et al.*, 2004a). However, most of irrigators' associations including traditional irrigation schemes in Nyandira are not registered and they do not have a water permit. Most of the irrigators do not respond to payment request from the Wami/Ruvu Basin office,

previously they used water as a free commodity that made them to be reluctant in paying for the water permits. In fact, only 30% of users are paying for the water permits to the Basin office where this study is focused (Ngana *et al.*, 2010). Traditional irrigation schemes under irrigators' associations require Government support. However, there is less support of the Government in the traditional canals because most of them are not registered and they do not have a valid water permit. Irrigation is managed and improved by farmers themselves thus its survival is questionable (Lankford, 2003).

A study conducted in South Africa reported that, smallholders irrigators' were ready to pay considerably higher water prices with respect to the water permits if those fees were tied to grants provided by the Government, so as to ensure the improvements in the traditional irrigation schemes (Speelman *et al.*, 2010).

Despite of the Tanzanian Government giving high priority to the development of the irrigation sector, most of the traditional irrigation schemes have barely survived. This is because of the lack of Government's intervention to the water user associations which are not registered and hence they do not have water permit (Tarimo, personal communication, 2013). The institutions that are involved in water management are loosely connected and lack basic coordination and are often at the periphery of the water management agenda (Sokile *et al.*, 2003). Most traditional schemes are characterised by low skills and awareness of the roles and responsibilities of the stakeholders, inadequate financing, weak enforcement of by-laws, absence of irrigation legal framework, inadequate facilities and the number of qualified staff (URT, 2010).

The study is in line with the National Strategy for Growth and Reduction of Poverty (NSGRP) II, which emphasizes on water conservation for irrigation development (NSGRP,

2010). Also this study is in line with Dublin Principles of Integrated Water Resources Management, which highlight gender participation and water permit in irrigation activities (Preetha, 2013). That ensured the effective management for irrigation development which has enabled high productivity and sustainability (Solanes and Villareal, 1999).

2.4 Conceptual Framework

The conceptual framework of the study was based on the assumption that background variables such as age, sex, education, household size, marital status, household composition, location of the canal and land ownership had a direct influence on institutional factors and other factors. Institutional factors (independent variables) were guided by indicators of influence such as users conformity to rules and regulations, provision of punishment, rules of water distribution, enforcement of water payment fees and water committee. Other factors (independent variables) included gender relations, pipeline water supply, conflict status, conservation of natural vegetation along the canal, rehabilitation of irrigation infrastructure and water distribution between upstream and downstream had direct influence on survival of traditional irrigation schemes in Nyandira (dependent variable). On the other hand, institutional factors and other factors which are independent variable have direct influence to the dependent variable which was survival of traditional irrigation schemes at Nyandira. The dependent variable was measured by Annual cost spent in rehabilitation of irrigation infrastructures.

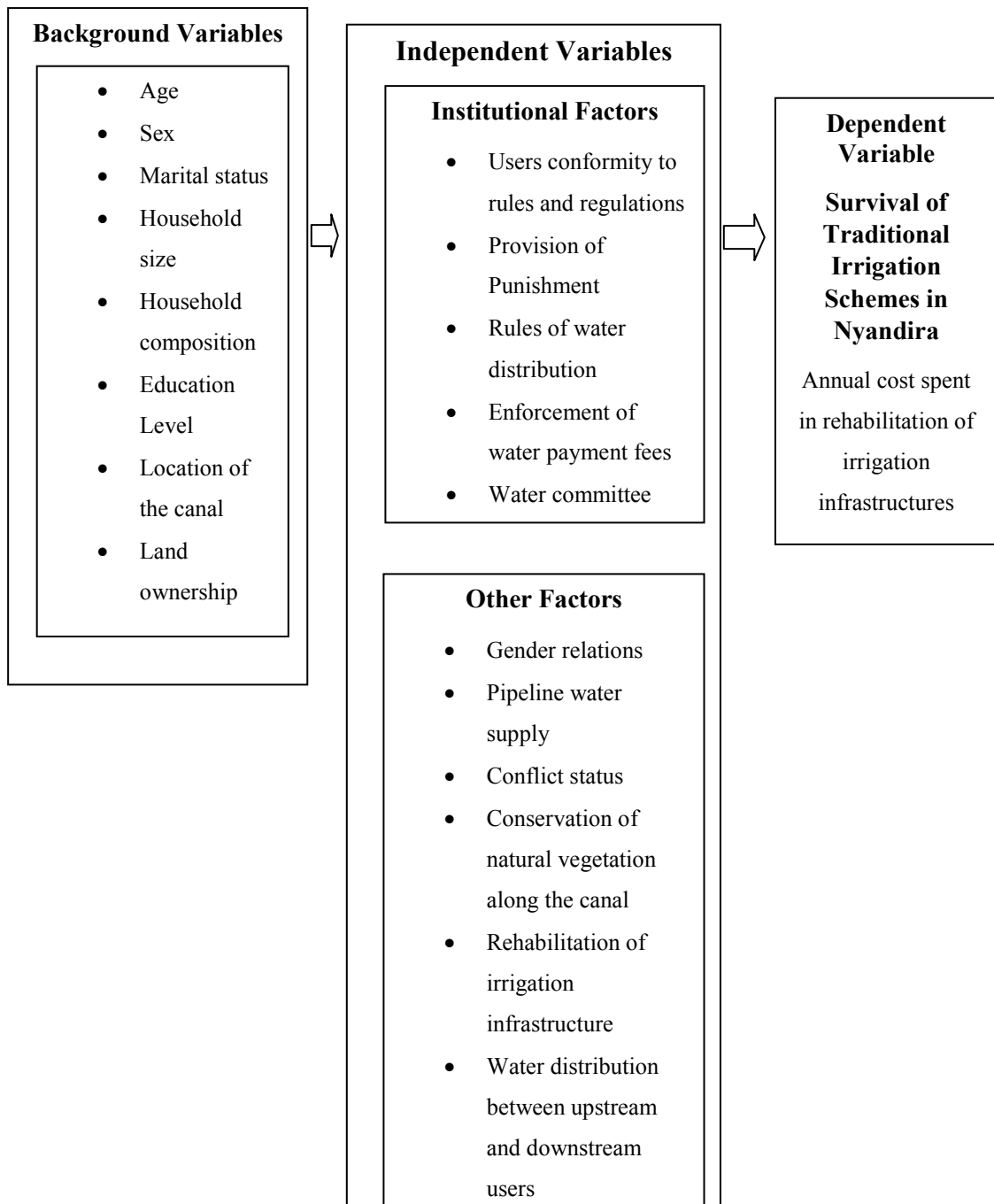


Figure 1: Modified Conceptual Framework from Structural Functionalism Theory of Emile Durkheim by Kombo and Tromp (2006).

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Nyandira Ward in Mvomero District, with a total population of 8 644 people (4 000 males and 4 644 females). Kibuko, Ndugutu, Muharazi and Nyandira villages have a population of 1 800, 1 837, 2 580 and 2 427 people, respectively. The Ward constitutes four villages. It is bordered by Langali Ward to the north, Tchenzema Ward to south and Kikeo Ward to the west. Nyandira Ward is located in the mountainous zone of Uluguru mountains about 06° 58' South and 37° 41' East and is part of the Eastern Arc Mountains (Lubida, 2004). The Uluguru Mountain's highest attitude is 2630m above mean sea level with rainfall over 3 000 mm per annum (Ngana *et al.*, 2010). Nyandira is surrounded by rivers, springs and streams which have motivated indigenous agricultural practices with crops such as maize, beans, peas, sunflower, potatoes, tomatoes, cabbages, cucumber, carrot, paprika, salad, and fruits being grown. The people in Nyandira village have been practicing intensive terrace cultivation and irrigation for more than 80 years now. There are ten major canals in Nyandira village namely; Fuku, Mbakana Juu, Mbakana Kati, Mbakana Chini, Mzinga, Mindu 1, Mindu 2, Nyamiseta, Lubangala 1 and Lubangala 2. However, Fuku remains leading WUA with substantial informal institution associated with strong leadership (Kidawalo, personal communication, 2014).

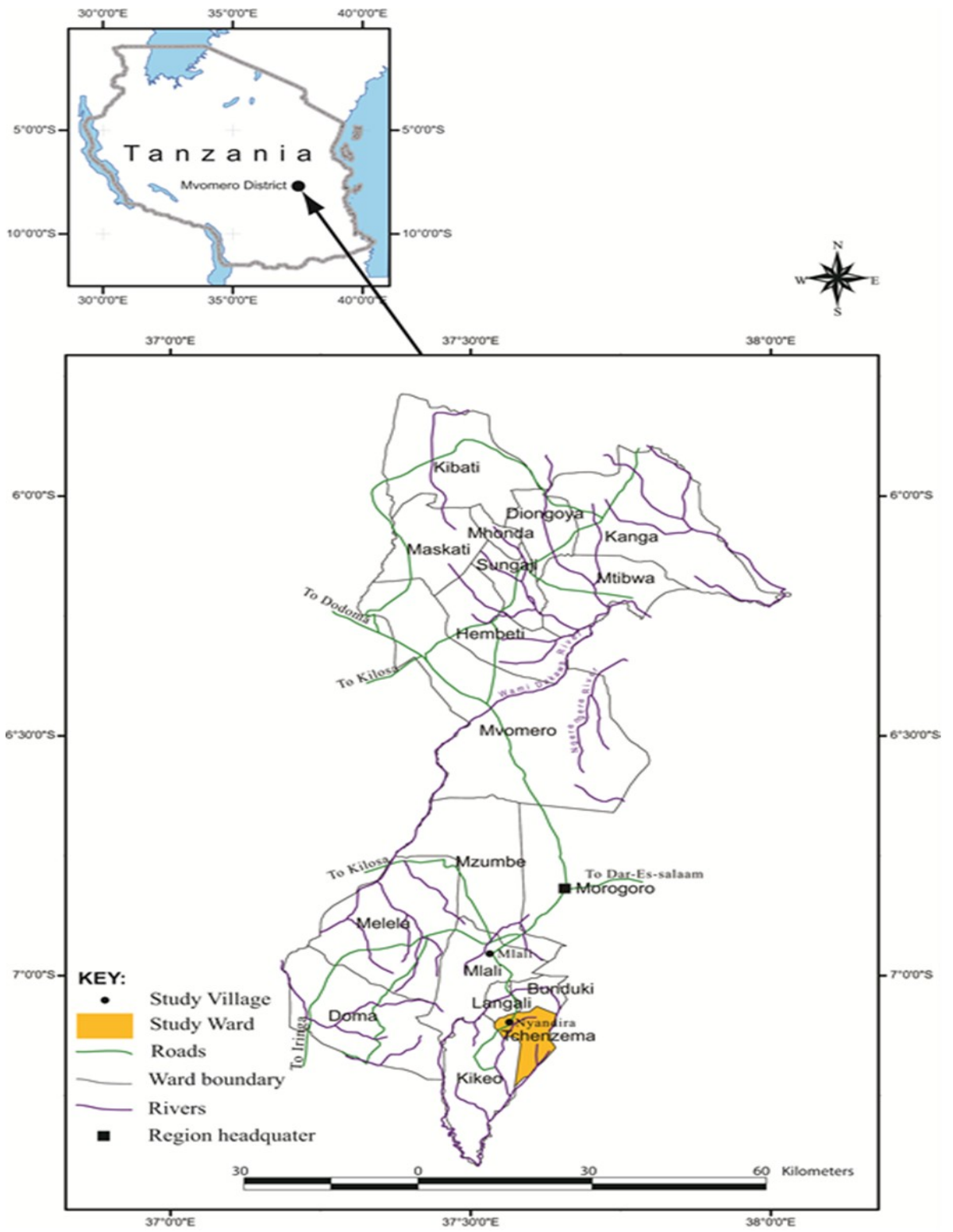


Figure 2: Location Map of the Study Area.

3.2 Research Design

Cross sectional research design was used in this study because it allows collection of data in more than one case at a single point in time and detection of patterns of association among variables (Bryman, 2004). The design allows collection of qualitative and quantitative data at minimal cost (Agresti and Finlay, 2009). This design is flexible and economic (Kothari, 2004).

3.3 Sampling Procedure and Techniques

A multistage sampling technique was used to select District, Ward, Village and respondents. Purposive sampling technique was used to select Nyandira Ward based on the fact that traditional irrigation schemes have been there since 1920s. A simple random sampling technique was also used to select four irrigators' associations from the list of ten WUAs, so as to ensure diversity of information from different WUAs because of their heterogeneity. Lastly, simple random sampling technique was used to select non-members' categories such as private users, non-members along the canal and pipeline water supply irrigators from a list which was provided by the Village Government office. The reason for including the other categories than members only is because water in the canal is used by all categories in the Ward. A summary of the sample is presented in Table 1.

Table 1: Sample Distribution of the Respondents

	Water User Associations				Total
	Members	Non-members			
		Private users	Along the canal	Tap water system users	
Fuku	33	8	10	15	66
Mzinga	20	7	10	15	52
Mbakana	18	0	10	15	43
Nyamiseta	14	0	10	15	39
	85	15	40	60	200

3.4 Methods of Data Collection

Both qualitative and quantitative data collection methods were used due to the nature of the study. If qualitative or quantitative methods had been used separately the results would not have been relevant because some of the information had to be quantified while other information needed to dig deep so as to find out what had been happening, why and how.

3.4.1 Primary Data Collection

Data were collected from four irrigators' associations namely Fuku, Mzinga, Nyamiseta and Mbakana so as to address the study objectives. The data were collected from both members and non-members (including private users, non-members along the canal and pipeline users) using a structured questionnaire with both open and closed ended questions. The questionnaire was pre-tested to check its reliability and validity for improvement before using it as a tool for data collection.

A checklist was used to collect information from twelve key informants who had a good background of the irrigation schemes in Nyandira Ward. The key informant interview involved two Ward leaders, two Village leaders, four members from irrigators' associations, two extension officers and finally one representative each from Uluguru Mountain Agricultural Development Project (UMADEP) and Mtandao wa Vikundi vya Wakulima Tanzania "*Tanzania Farmers Network Association*" (MVIWATA).

A Focus group discussion method was used to collect information from 20 participants. Two focus group discussions (FGD) composed of 10 participants each were conducted. Gender was considered in the selection of the participants in the FGD. Women participants were separated from men so as to make them feel free to share information. FGD 1 was used to collect information from male participants while FGD 2 was used to collect information from female participants.

Five categories were involved to select participants for the FGDs, two representatives (both male and female) from members of WUA's category, two representatives (both male and female) from private user's category, two representatives (both male and female) from the category of non-members who live along the canal, two representatives (both male and female) from the category of irrigators who have been irrigating by using pipeline water supply and the last category constituted the founding members (both male and female) of the WUA. The selection also ensured representation of all four WUAs namely; Fuku, Mbakana, Mzinga and Nyamiseta.

3.4.2 Secondary Information

Secondary information was obtained from various sources including irrigation, agriculture and gender related theses and books from the Sokoine National Agricultural Library

(SNAL) and online sources. Agricultural and irrigation policy reports by United Republic of Tanzania were also used as a source of secondary information.

3.5 Data Analysis

Qualitative data were analysed using content analysis, while quantitative data were analysed using Statistical Package for Social Sciences (SPSS) where relationships between variables were shown. Both descriptive and inferential statistical analyses were used in the study. SPSS was used to compute descriptive statistics such as frequencies, percentages and for cross tabulation. Inferential statistics such as chi-square, independent sample t-test and multiple linear regression models were also used to analyse the quantitative data.

Objective 1: Institutional Factors that Govern Traditional Irrigation Schemes

Data were analysed by a multiple linear regression model in order to determine the institutional factors that govern traditional irrigation schemes in Nyandira. This model was appropriate in determining the factors which had significant influence to the survival of traditional irrigation schemes. Ten institutional factors were regressed in the equation, to be able to determine the significant factors that have influenced the survival of traditional irrigation schemes in Nyandira. The multiple linear regression model expected to answer the theoretical question in Section 2.2 which asked ‘Do the institutions which have been governing WUA in Nyandira have any significant influence to the survival of the traditional irrigation schemes?’ Variables indicated in the model are shown in Table 2, Table 3 and Table 4. The linear regression equation (1) was constructed based on borrowing what was written by Pallant (2011), in order to analyse variables by using SPSS. Equation 1 is as follows;

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \beta_{10} X_{10} + \varepsilon_n \dots \dots \dots (1)$$

Where;

Y_1	=	Rehabilitation of irrigation infrastructure in a year (Annual cost spent in rehabilitation of irrigation infrastructures)
β_0	=	Constant of the equation
$\beta_1 - \beta_{10}$	=	Coefficient of the n th predictor
$X_1 - X_{10}$	=	Independent variables entered in the model
ε_n	=	Random error term
X_1	=	Age (Number of years)
X_2	=	Education level of Household head (0=Otherwise, 1=Educated)
X_3	=	Land ownership (0=Otherwise, 1=Own land)
X_4	=	Location of the canal (0=Tail, 1=Head)
X_5	=	Household size (Number of household members)
X_6	=	Water committee (0=Bad, 1=Good)
X_7	=	Rules on water distribution between head and tail (0=Otherwise, 1=Strong)
X_8	=	Users conformity to rules and regulations (0=Bad, 1=Good)
X_9	=	Provision of punishment for users who don't abide the rules (0=Weak, 1=Strong)
X_{10}	=	Enforcement of water payment fees (0=Otherwise, 1=Adequate)

Table 2: Dependent Variable (Survival of Traditional Irrigation Schemes)

Variable	Operational definition	Measurement	Unit
Cost of rehabilitation of irrigation infrastructure	The cost used to rehabilitate the irrigation schemes so as to keep canals function effectively	Ratio	Annual cost spent in rehabilitation of irrigation infrastructures

Table 3: Background Variables

Variable	Operational definition	Measurement	Unit
Age	Years since one was born	Ratio	Years
Sex	Biological difference between male and female	Nominal	1=Male 2=Female
Marital status	The state of having a spouse or not	Ordinal	1=Married 2=Single 3=Divorced 4=Widowed 5=Widower
Household size	Number of household members	Ratio	Number of people
Household composition	Head of household	Nominal	1=Male headed 2=Female headed
Education level	Level of education one has attained	Ordinal	1=Illiterate 2=Adult education 3=Primary 4=Secondary 5=College
Respondent's location along the canal	The place in which irrigator located along the same canal	Dummy	1=Head 0=Tail
Land ownership	The place where irrigators cultivate and irrigate	Nominal	1=Yes 2=No

Table 4: Independent Variables (Institutional Factors)

Variable	Operational definition	Measurement	Units
Users conformity to rules and regulations	The extent to which water users conform rules and regulations	Dummy	1=Good 0=Bad
Provision of punishment	Provision of punishment for users who failed to abide the rules and regulations	Dummy	1=Strong 0=Weak
Rules on water distribution	Rules to ensure equal distribution of water between the upstream and downstream users based on the rotational schedule	Dummy	1=Strong 0=Otherwise
Enforcement of water payment fees	Rules that monitor collection of money obtained from fines, fees and service charges that ultimately directed on rehabilitation of canals	Dummy	1=Adequate 0=Inadequate
Water committee	The committee responsible for water related issues within the particular WUA	Dummy	1=Good 0=Bad

Objective 2: Gender Relations among Actors in Traditional Irrigation Schemes

It was hypothesized that, gendered irrigation activities is more likely to influence the survival of traditional irrigation schemes in the study area. This is because gendered society creates equal opportunities to the access to and control over resources, farm and irrigation activities. This would increase motivation and team work between users in both farm and irrigation activities. Data were analysed based on the adoption of Harvard analytical framework which was developed in 1980 by Harvard Institute for International Development in collaboration with USAID (March *et al.*, 2005). This was done in order to measure gender relations and their implication on survival of traditional irrigation schemes in which seventeen variables were assessed. In activity profile, the indicators such as farm

preparation, cultivation, irrigation, harvesting, selling, budgeting, fetching water for domestic purposes, rehabilitation of the canal, conflict resolution, water distribution, fee collection and security of the canal were included. In access and control over resources the indicators such as farm equipment, irrigation equipment, decision making, benefits and land were used. Sixteen categorical answers were used to collect information from the respondents on the access to and control over resources as well as farm and irrigation activities as indicated in Table 5.

Table 5: Gender Relations (Other Factors)

Variable	Operational definition	Measurement	Unit
Activity Profile	Rights, responsibilities	Nominal	1=Mostly Young Male
Farm preparation	and identities of men		2=Young Male Only
Cultivation	and women in access		3=Mostly Young Female
Irrigation	and control over		4=Young Female Only
Harvesting	resources as well as		5=Mostly Adult Male
Selling	farm and irrigation		6=Adult Male Only
Budgeting	activities		7=Mostly Adult Female
Fetching water			8=Adult Female Only
Rehabilitation of canal			9=Mostly Old Male
Conflict resolution			10=Old Male Only
Water distribution			11=Mostly Old Female
Fee collection			12=Old Female Only
Security of canal			13=Male Leaders
Access and Control Profile			14=Female Leaders
Farm equipment			15=All Leaders
Irrigation equipment	e.g Hand hoe, machete e.g Pump, water		16=All Genders
Decision Making	e.g By who?		
Benefits	e.g Profit		
Land	e.g Used for production		

Objective 3: Attitude of Irrigators towards Water Permit Systems

To capture this objective, Likert scale of twelve statements was constructed based on the attitude of irrigators towards the water permit systems and the survival of traditional irrigation schemes in the study area. Respondents were requested to say whether they strongly agree, agree, are neutral, disagree or strongly disagree against each statement. A five point Likert Rating Scale (LRS) was graded as follows: Strong Agree = 5; Agree = 4; Neutral = 3; Disagree = 2; Strong Disagree = 1 (Pallant, 2011). However, in order for the results to be more meaningful the scale were merged into three LRS as follows: Agree = 2, Neutral = 3 and Disagree = 4. Ultimately the general attitude of all respondents was presented after the average of percentages on the Agreed, Neutral and Disagree was computed to form the cut-off points of $12 \times 5 = 60$ as the highest, $12 \times 3 = 36$ as the medium and $12 \times 1 = 12$ as the lowest in which the average scores between 12-35 indicated negative attitude, 36 indicated neutral attitude while 37-60 indicated positive attitude. Furthermore, independent sample t-test was used to compare the mean scores of attitudes between members and non-members after the scores were computed as continuous data.

Objective 4: Operationalization of the Survival Status in Nyandira

Data were analysed by descriptive statistics and Chi-square so as to operationalize the survival status in the study area which is guided by the indicators such as improvement of irrigation infrastructure, fair distribution of water between upstream and downstream users, conflict status and conservation of natural vegetation along the canal. The level of measurement of indicators were nominal and ordinal in order to comply with the measurement of indicators (Table 6).

Table 6: Independent Variables (Other Factors)

Variable	Operational definition	Measurement	Units
Conservation of natural vegetation along the canal	Process of pruning unnecessary vegetation that reduces the water flow in the canal	Dummy	1=Conserved 0=Otherwise
Rehabilitation of irrigation infrastructure	Process of rehabilitating the canals so as to make it function effectively	Dummy	1=Yes 0=No
Water distribution between upstream and downstream users	Distribution of water between the upstream and downstream users along the same canal based on the rotational schedule	Dummy	1=Fair 0=Unfair
Conflict status	The state in which water users' conflict occurs	Ordinal	1=Mostly occurred 2=Less occurred 3=Not occurred

3.6 Limitations of the Study

This study faced some setbacks during the course of survey. Most of the respondents (90%) were reluctant to provide information for free and seemed to be less cooperative and expected a so called 'time compensation payment' from the researcher. The researcher had to pay 2000 Tanzanian Shillings (Tshs) to each respondent who resisted to be interviewed.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Demographic Characteristics

The demographic characteristics of the respondents included age, sex, marital status, education level, household size, household composition, location of the canal, and land ownership. These variables were used to assess their contribution to survival of traditional irrigation schemes in Nyandira.

4.1.1 Age

The findings show that more productive age lied under the 31-46 years old whose frequency were the highest (Table 7). The table indicates that Nyandira has a large population who participate in farming activities that assure labour power which could be devoted to ensure sustainability of their schemes through maintenance, rehabilitation and being able to qualify for membership in WUAs simply because most of them have age limit of hardly 63+ years old. Agwu and Edun (2007) reported that labour power in irrigation activities will be assured by having a proportional age of 20 to 50 years old because that is the most productive age in a society. However, elders should not be ignored because they have got a comprehensive farming experience and a good understanding of trainings which have been given by different agencies. In Nyandira they are known as founding member and their contribution are particularly important in sustainability of schemes.

Table 7: Demographic Characteristics of Respondents (n=200)

Variable		Members		Non-members		Total	
		n	%	n	%	n	%
Age	15-30	28	32.9	36	31.3	64	32
	31-46	27	31.8	44	38.3	71	35.5
	47-62	23	27.1	25	21.7	48	24
	63+	7	8.2	10	8.7	17	8.5
Sex	Male	51	60	52	45.2	103	51.5
	Female	34	40	63	54.8	97	48.5
Marital status	Single	13	15.3	10	8.7	23	11.5
	Married	61	71.8	91	79.1	152	76
	Divorced	5	5.9	8	7	13	6.5
	Widowed	6	7.1	6	5.2	12	6
Household size	>3	70	82.4	91	79.1	161	80.5
	<3	15	17.6	24	20.9	39	19.5
Household composition	M headed HH	67	78.8	101	87.8	168	84.0
	F headed HH (de jure)	14	16.5	13	11.3	27	13.5
	F headed HH (de facto)	4	4.7	1	0.9	5	2.5
Education level	Primary	58	68.2	88	76.5	146	73
	Secondary	1	1.2	5	4.3	6	3
	Adult education	9	10.6	3	2.6	12	6
	Illiterate	17	20.0	19	16.5	36	18
Location of the canal	Head	45	52.9	59	51.3	104	52
	Tail	40	47.1	56	48.7	96	48.0
Land ownership	Yes	85	100	115	100	200	100
	No	0	0	0	0	0	0
Irrigation	Yes	84	98.8	93	80.9	177	88.5
	No	1	1.2	22	19.1	23	11.5

4.1.2 Sex

In order to understand who constitutes the study population, knowing the extent to which sex is involved is crucial. Table 7 indicates that out of the 200 respondents, 60% of the members and 45.2% of the non-members were males while 40% of the members and 54.8% of the non-members were females. Majority of males dominated the members' category because most of them represented their family in the WUAs membership list. This implies that both sexes were considered imperative in working together to address the irrigation challenges which had occurred. Being a man or women does not affect anything concerning membership or irrigation activities that envisages team work and cooperation that could influence survival of irrigation schemes. However these findings differ from Dauda *et al.* (2009), in Nigeria who reported that males had dominated in irrigation activities by 75% due to cultural factors that discouraged participation of women as a results their schemes did not survive.

4.1.3 Marital Status

Married couples are likely to be more productive than others due to assurance of labour supply in farm activities and access to productive resources in irrigation agriculture (Muywanga, 2004). Table 7 shows that 71.8% and 79.1% of the members and non-members were married, while single, divorced and widowed constituted 28.2% and 20.9% for both members and non-members respectively. It was revealed that people who were married had more access to production than others. This is because matriarchy has dominated in Nyandira that made a woman who wants to get married to be given a land. Therefore the more the married couples appear the more they have access to production than people who are single especially the men.

4.1.4 Education Level

Table 7, shows that majority (80%) of the members and 83.5% non-members had attained different levels of education Primary (73%), Secondary (3%) and Adult education (6%), while 17% and 19% of the members and non-members, respectively, were illiterate. It was further observed that people with secondary education had better skills of management than those with primary education. Likewise, those with primary education were better off than those without education. This agrees with a recent study conducted by January (2010) who reported that increase in education level leads to an increase in knowledge on the management of irrigation activities, thus the educated people have more knowledge of management approaches that would result to sustainability of traditional irrigation canals. Also the findings are in agreement with those of Liberio (2012) who reported that most farmers in Tanzania have acquired primary education and rely on traditional farming practices including irrigation.

4.1.5 Household Size

Households with family size of more than three people at Nyandira participated more in irrigation activities than those with one or two people. It was observed that larger families were using one of their members as representative when it comes to cleaning of ditches or attending meeting if the registered member is busy or sick. Therefore, if emergency happens then small family is less likely to participate in irrigation activities on behalf of somebody. Similar results was reported by Haji and Amani (2013), who said that a family with 3-6 members is likely to participate in the small-scale irrigation scheme more often due to nature of labour intensive required than a small family. Table 7 shows that the highest proportion (82.4%) and (79.1%) of the respondents from members and non-members had more than three members in their households. Therefore, only 17.6% and 20.9% of the respondents from members and non-members had less than three members.

These findings suggest that participation of people from each household had influenced the management of the traditional irrigation schemes in Nyandira.

4.1.6 Household Composition

The findings presented in the Table 7, reveal that 78.8% and 87.8% of the respondents from both members and non-members were male headed households, while 21.2% and 12.2% of the members and non-members respectively had been led by the female headed households. This findings indicate that most of the decisions at the household level were probably influenced by men rather than women. This is similar to a report from a study done by UNFPA (2008) cited by Shekiango (2008) which showed that men's lives are usually characterized as heads of household or wage earners, while children and society benefit from men's active involvement with their families. According to the TDHS (2010), it was reported that about one quarter of Tanzanian households are headed by women. Nevertheless, Chibisa *et al.* (2008) reported that women marginalisation in irrigation schemes may compromise the effectiveness of traditional irrigation schemes because they are the ones who participate in farming activities more often than men.

4.1.7 Location of a Canal

Location of a canal has a role to play when it comes to irrigation water management. Upstream users seemed to face less stress on water distribution and conflict than the downstream users (Bhattarai, 2010). Table 7 shows that 59.2% of the members and 51.3% of the non-members were located at the head, while 47.1% of the members and 48.7% of the non-members were located at the tail. It was observed that in spite of the fact that water was being allocated equally between upstream users and downstream users, the upstream users had a tendency of blocking water and disrupt water distribution to the downstream users. The downstream users had to make a follow up when water was blocked and open

water for their turn. Therefore, being located at the head or tail had influenced negotiation on good terms of water distribution that improved water distribution and increased security against those who trespass and block water illegally.

4.1.8 Land Ownership

Table 7 shows that all respondents (members and non-members) owned land. Land ownership is very important in anticipating how the community is supposed to engage in agricultural activities including irrigation (Chifamba *et al.*, 2012). The study shows that women had access to and control over land more often than men, despite the fact that men were dominant in their households (male headed households). Based on the nature of Waluguru matriarchy society whose culture favour women by giving them power to dominate their households and giving them land when they are grown up and perhaps when they want to get married. After they have got married they will have the land which they have been given already. Therefore, their husbands have no choice other than investing in those plots even if they do not have their own believing that it is a family investment even though they will not own the plots anymore after they have divorced each other. For that reason it encourages them to combine their efforts with men in production activities which had a great influence on the rehabilitation of irrigation canals.

4.2 Institutional Factors Governing Traditional Irrigation Schemes

In the study, a multiple linear regression model was used to determine the institutional factors that had influenced survival of the traditional irrigation schemes. Five variables out of ten estimated in the model were found to be statistically significant at $p < 0.001$, $p < 0.01$ and $p < 0.05$ level. Those variables were enforcement on water payment fees, water committee, users conformity to rules and regulations, rules on water distribution and land

ownership. This implies that they were the most influencing factors for the survival of traditional irrigation schemes.

Findings in Table 8, show that the linear regression model was statistically significant (F-value = 73.512; p-value < 0.001). Significance of the model indicates that it could be used to predict the variables under the study. Multicollinearity exists when there is a strong correlation between two or more predictors in a regression equation. It is undesirable because if it had been included in the regression equation it would lead to instability of the regression model (Bryman and Cramer, 1993). Multicollinearity was evaluated using the Tolerance and Variance Inflation Factors (VIF) estimated for each independent variable in the regression equation. Mtelevu and Kayunze (2014) argued that the Tolerance value of less than 0.1 and VIF above 9 suggests a problem of multicollinearity. Independent variables tested for multicollinearity agreed with the assumptions, which means the model was fine.

The dependent variable (cost spent in rehabilitation of irrigation infrastructure) was regressed against ten independent variables including age, education level, land ownership, location of the canal, household size, water committee, rules on water distribution between upstream and downstream users, users conformity to rules and regulations, provision of punishment and enforcement of water payment fees. The regression results show a multiple correlation of $R = 0.793$. This means that, the independent variables used in regression model were associated with the dependent variable by 79.3%. The multiple coefficient of determination (R^2) obtained was 0.692, which is regarded as the strength of the dependent variable to explain the fitness of the model. This means that the independent variables entered in the model had the ability of explaining the variation in the dependent variable by 69.2%. It implies that institutional factors have shown the strong relationship with

sustainability of traditional irrigation schemes in Nyandira by 79.3% while the independent variables which were included in the linear regression model have shown a strong relationship with the dependent variables by 69.2% (Pallant, 2005).

Table 8: Results from Multiple Linear Regression Model

Independent Variable (X)	Beta (β)	Std. Error	t-value	p-value	Collinearity Statistics	
					Tolerance	VIF
Constant		0.111	73.636	0.000		
Age	+0.028	0.001	0.847	0.399	0.848	1.180
Education level of HH head	+0.007	0.043	0.210	0.834	0.906	1.104
Land ownership	+0.096	0.045	2.466	0.015	0.626	1.598
Location of the canal	+0.033	0.097	0.605	0.546	0.314	3.180
Household size	+0.021	0.011	0.609	0.543	0.835	1.197
Water Committee	+0.159	0.051	3.843	<0.001	0.557	1.795
Rules on water distribution	+0.125	0.047	3.140	0.002	0.597	1.676
Users conformity to rules and regulations	+0.060	0.201	4.546	<0.001	0.488	2.050
Provision of punishment	+0.045	0.043	1.233	0.220	0.703	1.423
Enforcement of water payment fees	+0.796	0.026	20.623	<0.001	0.637	1.570

R = 0.793, R Square (R^2) = 0.692, Adjusted R Square (R^2) = 0.631

Table 8 shows that all independent variables had positive coefficients of explanatory factors Beta (β) indicating that the more the independent variables increase the more they influence survival of traditional irrigation schemes in Nyandira. Furthermore, P-value shows whether the variables which were included in the Linear Regression model were statistically significant or not. If the variable was not statistical significant it means it did not influence survival of traditional irrigation schemes. If the variable was statistical significant it means it influenced the survival of tradition irrigation schemes in Nyandira very strongly.

Based on the question raised from the theoretical review which has been discussed in Section 2.2, institutions proved to be the influencing factor for survival of the traditional irrigation schemes in Nyandira.

Enforcement of water payment fees had a standardized coefficient of $\beta = +0.366$, statistically significant at $p < 0.001$ level of confidence. The positive regression coefficient implies that rules of water payment fees and rehabilitation of irrigation infrastructure were positively related. Increase in rules of water payment fee increases the chance of collecting more money that could be used for rehabilitation purposes. This is because the fees which has been contributed by users covered the rehabilitation cost, and as a result, the traditional irrigation schemes survived. Similar results were reported by van Averbeké *et al.* (2011) in a study done in South Africa. The study revealed that enforcement of water payment fees has a profound contribution to the maintenance of irrigation canals. This is done because inadequate maintenance of the canal reduces water delivery and shortens the sustainability of the canals.

Water Committee has influenced the survival of traditional irrigation schemes. The findings showed that the Committee's fulfillment of their obligations had a positive influence ($\beta = +0.159$), statistically significant at the $p < 0.001$ level of confidence. This implies that the water Committees in WUAs fulfilled their tasks that made the performance of the canals to be good. The water committee had been enforcing the maintenance of the canal differently among the WUA. For instance in Fuku the enforcement was very strong and a person who did not attend the maintenance work was punished for example he/she will compensate for each day he/she missed by paying 5000 Tshs. Mbakana and Mzinga had the same system of enforcing rehabilitation of the canal by punishing its members. This was contrary in Nyamiseta whereby the committee did not punish its members who did not

attend for maintenance activities. Instead, the committee warned the members who in turn agreed to rehabilitate their canal. Nkambule and Dlamini (2013) reported similar results in a study done at Maplotini irrigation scheme in Swaziland. The study reported that the irrigation scheme was managed by a committee which was elected annually. The main role of the irrigation committee was to manage and administer all operations taking place in the scheme for the purpose of improving its performance. Ultimately the Maplotini irrigation scheme survived.

Rules on water distribution had a standardized coefficient of $\beta = +0.125$, statistically significant at $p < 0.01$ level of confidence. The positive regression coefficient implies that rules on water distribution and rehabilitation of irrigation infrastructure were positively related. Rules on water distribution has enabled an equity of irrigation water supply between the upstream and downstream users especially at Fuku and Mzinga WUAs. Due to that reason, water users' had been motivated to engage fully in operation and rehabilitation of their canals that has made their canals to survive. Nkoka *et al.* (2014) reported similar results in a study done in Mozambique. The study articulated the significance of enforcing rules on water distribution between upstream and downstream users. Rotational schedule of two days for upstream users and two days for downstream users was used. The system made all users to participate in operation and maintenance of the canals which led to sustainability of the traditional canals.

Land ownership had a standardized coefficient of $\beta = +0.096$, statistically significant at $p < 0.01$ level of confidence. The positive regression coefficient implies that land ownership and rehabilitation of irrigation infrastructure were positively related which means the more people own land it increases their chance of irrigating and rehabilitating their canals simply because they would be practicing farming and irrigation more than the ones who don't have

plots. The more the users own land the more chance of rehabilitation of irrigation infrastructure. This is because people would be motivated to engage themselves in irrigated agriculture which has a bearing on water availability in a canal. To ensure constant water supply for agricultural and other domestic uses such as bricks making, washing dishes, feeding animals and cooking they do not have a choice other than to maintain their canals. Finger and Borer (2013) reported that land ownership determines people's participation in agricultural and irrigation activities. The more a person owns land the more he/she participates in WUA activities including maintenance of the canals. This has a very strong bearing to the survival of the irrigation systems.

Users conformity to rules and regulations had a standardized coefficient of $\beta = +0.060$, statistically significant at $p < 0.001$ level of confidence. The positive regression coefficient implies that users conform to rules and regulations and rehabilitation of irrigation infrastructure were positively related, thus the more the users conform to rules and regulations the more chance of rehabilitation of irrigation infrastructure. This has a direct implication on the survival of their irrigation canals. These results correspond to those of Cakmak *et al.* (2005) who reported that Soke irrigation association in Turkey has influenced the survival of traditional irrigation schemes to be successful, because members were conforming to rules and regulations that governed their association.

Respondent's location at the canal had a standardized coefficient of $\beta = +0.033$, statistically insignificant at $p > 0.05$ level of confidence. The positive coefficient Beta implies that the more balanced number of respondents at the head and tail the more it influences survival of schemes, this is because being located at the head could motivate the users to keep their canal function. The reason for insignificance was because of several conflicts on water distribution that had an effect on rehabilitation and maintenance of canals especially at

Nyamiseta and Mbakana WUAs. It was observed that conflicts emanated due to some upstream users who deliberately blocked water even though they knew it was against rules and regulations of WUAs. If people were abiding on rules and regulations on water distribution perhaps this variable would have been significant towards the survival of traditional irrigation schemes.

4.3 Gender Relations in Irrigation

Table 9 shows how gender and age group are represented in Nyandira. It was observed that all gender were included in irrigation and farming activities regardless of sex and age groups. Youth of both sex dominated in these activities because most of them were energetic and were mostly demanded by WUAs as members. Nevertheless, children of both sex had been participating in agricultural activities to support their parents or grandparents. On the other hand elders of both sex were also participating in irrigation and farming activities. These findings imply a well representative of gender equality in irrigation activities which projects a milestone towards survival of irrigation schemes. Because all genders are included then it creates a sense of ownership to each individual in the WUA, therefore, it could influence intensive care, security, full participation and team work among members in decision making, planning, operation and maintenance of the canal. According to Bentvelsen (2004), gender mainstreaming in irrigation should be given first priority because it influences fair decision making that touches all genders whose target is to deliver as one, if this is done it would ensure endless irrigation management in an association.

Table 9: Gender vs Age Group (n = 200)

Age group	Sex of Respondents			
	Male		Female	
	n	%	n	%
Children (under 18 years)	24	23.30	26	26.80
Youth (18 years to 54 years)	60	58.25	49	50.51
Elders (55 years and above)	19	18.45	22	22.68
Total	103	100.00	97	100.00

Plate 1 shows how gender is considered imperative in irrigation activities and maintenance of canals. This is very common in Nyandira, it creates a good chance of developing and maintaining their canals. It was observed that children were very keen to participate in irrigation activities and they were also very strict in maintaining irrigation scheduling especially watering plants at the exact time as required, and also to keep an eye on the progress of their parents/grandparents farms. From that view, when they grow up they will have been keeping and taking the same spirit to ensure their canals are sustainable.



Plate 1: Gender Manifestation in Irrigation Activities in Nyandira

The Harvard analytical framework was adopted from March and Mukhopadhyay (2005) to capture access to and control as well as activity profiles. This was done to indicate who had more access to and control over resources, and to highlight the division of labour on farm and irrigation activities between male and female of all age groups such as children, youth and elders. Eventually, sixteen categories which have been articulated in Section 3.5 were merged to three and became; 1 = Male (Children, Youth and Elders), 2 = Female (Children, Youth and Elders) and 3 = Both gender, in order to bring simple information.

Table 10 shows that majority (95%) of the respondents stated that both gender have opportunities for farm and irrigation activities (children, youth and elders). This indicates that both gender had been working together in farm preparation, cultivation, irrigation,

harvesting, selling, budgeting, fetching water for domestic purposes, rehabilitation of the canal, conflict resolution, water distribution, fee collection and security of the canal. The plausible reason for that could be the dominance of matriarchal system where women are given power over land. Because women are being given land as a gift or inheritance, then when they get married they share the lands with their husbands. Husbands consider the land which has been given to their wives as part of family where they have got to invest for the family, luckily enough they are not restricted by their wives when they want to invest in it. In that case, all genders were included in irrigation and agricultural activities because nobody could not restrict either sex of all age groups to participate in irrigation activities. Nosheen *et al.* (2008) reported that gender relations in agricultural activities were carried jointly in a study conducted in Pakistan because of capacity building and sensitization. At first women and children of both sex were considered less important in agricultural activities but it came the time when they discovered that their contribution in agricultural activities were much important because they were the one who had been working hard on farm and they had an interest than males of all age groups.

Table 10: Gender Participation in Farm and Irrigation Activities (n = 140)

Variable No	Activity Profile (%)		
	M	F	B
1. Farm preparation	0	0	100
2. Cultivation	0	0	100
3. Irrigation	0	0	100
4. Harvesting	0	0	100
5. Selling	0.7	1.4	97.9
6. Budgeting	31.4	20.7	47.9
7. Fetching water	1	2.1	96.9
8. Rehabilitation of canal	0.7	1	98.3
9. Conflict resolution	0	0	100
10. Water distribution	0	0	100
11. Fee collection	0	0	100
12. Security of canal	0	0	100
Mean average	3	2	95
Total mean average		100	

Key: M = Male (Children, Youth and Elders), F = Female (Children, Youth and Elders), B = Both Gender

Table 11 shows that majority (94%) of the respondents uncovered that both genders had access to agricultural resources. Furthermore, 95% of the respondents, revealed that both genders had an equal chance over control agricultural resources. It was revealed that some of the men did not have their own land, but they cultivated on their spouse's plots. They did all irrigation activities together as well as the selling of crops to the market and the income from the sales was equally shared. The reason behind gender equality and equity was the dominance of the matriarchal system in which women had more power over the access to and control of land which they had inherited from their parents. Most men relied on buying land or cultivating on spouses plots.

Table 11: Overall Access to and Control over Resources (n = 140)

Variable	Access			Control		
	%			%		
No	M	F	B	M	F	B
1. Farm equipment -Hand hoe -Panga	0	0	100	0	0	100
2. Irrigation equipment -Pumps -Canal and Pipeline water supply	0	0	100	2	2	96
3. Decision Making	4	3	93	4	4	92
4. Benefits	0	0	100	4	3	93
5. Land	0.7	1.4	97.9	2	5	95
Mean average	3	3	94	2	3	95
Total mean average	100			100		

Key: M = Male (Children, Youth and Elders), F = Female (Children, Youth and Elders), B = Both Gender

From Table 11, access to and control over resources were done by both gender such as farm equipment, irrigation equipment, decision making, benefits and land it indicates that gender equality was motivated them to participate equally in irrigation activities. In that

respect, they had created a sense of ownership and patriotism that increased their participation to do operational and rehabilitation related activities in their WUAs. This influenced the survival of traditional irrigation schemes.

Similar results were observed by Upadhyay *et al.* (2005) who reported that women were increasingly consulted by their male counterparts before making a decision of irrigation activities and most of the decisions were made jointly. This was because of awareness created by gender activist who has been demanding equality of all genders in decision making, planning and conducting irrigation activities.

Macha and Mdoe (2002) in a study conducted in Kilosa District, Morogoro Region in Tanzania, reported that 88% of women had access to resources, including income from agricultural output, but they did not have full control of it because patriarchal system is dominant. Zwarteven (2008) in his study in Nepal, reported that even though women are active in handling the farm activities and irrigation fields, yet their responsibilities and visibility in the formal and public parts of irrigation management are often restricted by men due to cultural bias.

4.4 Attitude of Irrigators towards Water Permit Systems

Likert scale was used to analyse information from the respondents so as to capture information on their attitude towards the water permit systems and survival of traditional irrigation schemes in Nyandira. A total of twelve statements were used (six positive and six negative) to capture the attitude of the respondents. The reason behind the choice of this method is because the Likert scale is appropriate for measuring attitude (Kothari, 2004).

Figure 3, shows that more than half of the respondents were in the highest category of positive attitude (57%). Those with negative attitude were 30% and those with neutral attitude were 13%. This indicates that most of the irrigators in the study area believed that water permits had a significant factor towards survival of traditional irrigation schemes in Tanzania because they were told by NGOs that water permits could contribute to their canal to be sustainable. It was reported that irrigators who had attended training that were provided by UMADEP and MVIWATA had a better understanding of the significance of water permits in securing irrigation schemes. These results agrees with a study conducted by Akudugu (2013), which insisted that water permits can have a significant relationship towards sustainability of traditional canals. This is because they create awareness in water management, resources management and rehabilitation of irrigation infrastructure which has an implication towards survival of the traditional canals.

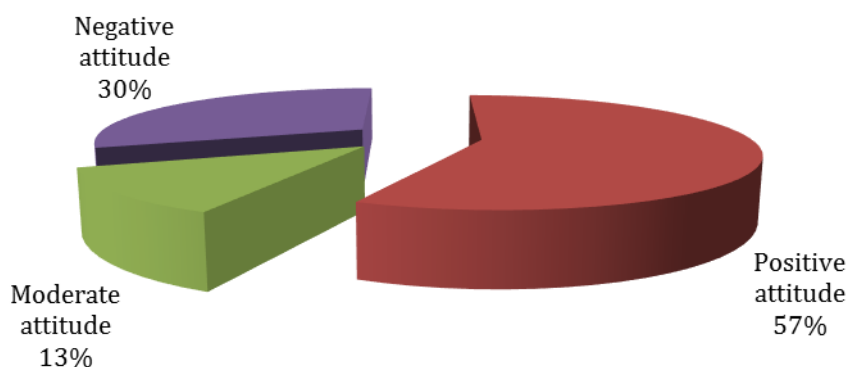


Figure 3: Overall Attitude of Respondents.

The mean score of the attitude between members and non-members were compared with the independent sample t-test, and the results in Table 12 shows that they were statistically significant at $p < 0.001$ level of confidence. This indicates a difference between the groups (members and non-members). The reason may be due to awareness which members had about water permit systems than non-members. Also they have been pressed by the local

Government to register for the water permits which will enable them to have access to Government funds for rehabilitation of their canals. If this is done, it may enhance the survival of traditional irrigation schemes.

Table 12: T-test Results for Attitude between Members and Non-members

Variable	Levene's Test for Equality of Variances		T-test for Equality of Means						
	F-value	Sig	T-test	Degree of freedom	Sig (2-tailed)	n	Mean	Mean difference	Standard deviation
Members	0.108	0.743	5.042	13	<0.001	85	43.14	4.650	5.566
Non-members			5.173	124.9	<0.001	55	38.49	4.650	4.940

Despite efforts that have been made to disseminate information on the importance of water permit systems in WUAs, its enforcement seems to be a challenge. The study done by van Koppen *et al.* (2004a) has shown that the implementation of water permits and fees system in small scale water users in Tanzania is still a challenge because most of irrigators seem not to have them and were ignorant of its existence. Komakech *et al.* (2011a) reported that, implementing the water permits and fee system in a basin where the majority of the water users are smallholder farmers who often already use and manage water under their own locally developed water rights regimes is a significant challenge.

Table 13: Attitude of Irrigators (n = 140)

No	Statement	Disagree		Neutral		Agree	
		n	%	n	%	n	%
1.	A valid water permit can prevent land grabbing from big investors (+)	11	7.9	11	7.9	118	84.3
2.	Having a water permit can solve the water use conflict between upstream and downstream users between canals along the same stream (+)	9	6.4	7	5.0	124	88.6
3.	A valid water permit to WUA is the key for the survival of the traditional canals (+)	7	5.0	20	14.3	113	80.7
4.	Water permit should be vested in the Ward level so that all people in the Ward will be benefited (-)	73	52.1	8	5.7	59	42.1
5.	Water permit should be vested to the WUA so as to benefit the members only (+)	59	42.1	2	1.4	79	56.4
6.	Water permit increases the morale to work, accountability and commitment of the owners to water conservation and security (+)	34	24.3	31	22.1	75	53.6
7.	Most of the members in your association don't have enough knowledge on a water permit (-)	60	42.9	13	9.3	67	47.9
8.	Most irrigator's associations don't have a water permit because it is very expensive to pay for the permit annually (-)	39	27.9	34	24.3	67	47.9
9.	Running a water association without a valid water permit is illegal (-)	67	47.9	37	26.4	36	25.7
10.	Water permit is a threat in creating classes of haves and have not in the same area thus exploitation will be inevitable (-)	81	57.9	10	7.1	49	35.0
11.	Having a permit is a condition of the government's assistance (+)	48	34.3	27	19.3	65	46.4
12.	WUA's leaders are less concerned in making follow up on water permit and they don't know even the price (-)	25	17.9	11	7.9	104	74.3
Average scores		42	30	18	13	80	57

Table 13 revealed that, 46.4% of the respondents acknowledged that having a water permit is a condition for Government's assistance. Therefore, they were desperately struggling to rehabilitate their canal on their own. Thus if they had water permits, the Mvomero District

Council may have helped them to improve their irrigation systems. The participants in the focus group discussion asserted as follows:

“We are facing a problem of water seepage because our irrigation infrastructure is not good enough. Last year we heard that Tanzanian Government under the Ministry of Agriculture through department of irrigation has been helping numerous WUAs under the condition that they are registered with water basin office. Therefore, we are planning to register ours so that we can have access to the funds for rehabilitation in order to consolidate our canals for sustainability of the systems”.

4.5 Operationalization of Survival Status in the Study Area

4.5.1 Contribution of Tap Water System to Irrigation Activities

Tap water supply system has contributed to the survival of the traditional schemes because it was considered to be a back-up system during dry seasons to supplement the little irrigation water in the canals. All water users' associations had access to pipeline water supply. The tap-water system is communally owned in which all users are obliged to pay 10 Tsh. for each 20 litres bucket of water. On the other hand, 3000 Tsh. is paid by each irrigator who wanted to irrigate for half a day. Table 14 shows that 46.7% of the respondents reported to irrigate their crops using tap water to supplement canal irrigation water when needed, especially during the dry season. Fifty three point three percent of the respondents reported to irrigate using irrigation water from canals only. This is a big drop from 91.6% of the respondents who had irrigated in the rainy season using water from canals. However, the whole process of irrigation using pipeline water supply did not have a substantial reduction of the water for domestic uses. Table 14, shows that 60% of the respondents reported that domestic uses and irrigation were done simultaneously due to water availability. However, about 40% of the respondents felt that the water is not enough to cover both domestic and irrigation activities at the same time. But 66.7% of the respondents said that domestic uses is given higher priority compared to irrigation when

water is scarce. This shows the importance of the tap water system for the survival of the schemes.

Table 14: Users of Tap Water System

Variable	Indicator	n	%
Source of water for irrigation during the rainy season	Canal	55	91.6
	Tap	5	8.4
	Total	60	100
Source of water for irrigation during the dry season	Canal	32	53.3
	Tap	28	46.7
	Total	60	100
Response on whether water is enough for irrigation and domestic uses	Enough	36	60
	Not enough	24	40
	Total	60	100
The prioritization of water distribution when water is scarce	Domestic uses	40	66.7
	Irrigation	20	33.3
	Total	60	100

These findings are contrary to those which were reported by Machibya and Mdemu (2005), which used rainfall as a supplement of irrigation instead of tap water. Irrigation development in the Usangu Plains in Tanzania has been extremely successful because the irrigators use rain water to supplement irrigation water during land preparation in the rainy season.

4.5.2 Water Distribution between Upstream and Downstream Users

Table 15 shows that there was variation of water distribution between upstream and downstream users. 87.8% of the respondents located at the head said that the water distribution was fair. On the contrary, 69.7% of the respondents located at the tail claimed that the process of water distribution was unfair. The Chi-square test confirmed that there was a variation ($p < 0.001$) of the responses on the irrigation water distributed between upstream users and downstream users. This indicates that the upstream water users are likely to realise the survival of traditional canals than the downstream users. However,

unequal water distribution may be a source of conflicts between them. It was observed that, the equity problem on water distribution had been in existence at Nyamiseta and Mzinga WUAs than Fuku and Mbakana WUAs. This was caused by their institutions being not strong enough to punish people who didn't abide rules and regulations, but they were just warned simply because they neither had a constitution nor a water committee. Most of the administrative issues have been run without any reference to written documents, unlike to Fuku and Mbakana which they have written constitution and a water committee.

However, it was observed that being located at the head or tail has nothing to do with the bias of the water which has been distributed to the beneficiaries. Irrigation water was distributed proportionally by the people appointed by the Irrigation Water Committee through the use of division boxes. But, people located at the head tend to block water illegally for their own uses even if it was not their turn. If Mzinga and Nyamiseta had a written constitution and water committee, to manage their WUAs and consolidating security during and after water distribution, they might be in a good position to end this problem. Participants from the FGD at Nyamiseta and Mzinga reported as follows:

“Water distribution is based on a rotational schedule which has been accepted by all users. For instance, on Mondays, Tuesdays and Wednesdays are for upstream users while Thursdays, Fridays and Saturdays are for downstream users. Sunday is a free day. However, some of the users located at the head have been using irrigation water illegally even though the schedule is known to all irrigators”.

Table 15: Irrigation Water Distribution (n = 140)

Variable	Indicator	Head		Tail		Total	
		n	%	n	%	n	%
Water distribution between upstream and downstream	Fair	65	87.8	20	30.3	85	60.7
	Unfair	9	12.2	46	69.7	55	39.3
$X^2 = 48.415$		df = 1		p-value < 0.001			

Sokile *et al.* (2005) reported similar observations in the Usangu Plains. Irrigation water rotations provide a successful water management in irrigation activities. Water users do agree on how to share water through rotational arrangements (*zamu*). This was done without external formal interventions on a weekly basis. Likewise, a study done at Makanya irrigation system in Tanzania by Komakech *et al.* (2011b) reported that, irrigation water has been based on schedule that shows who should get water, what quantity and for how long so as to ensure equity between the upstream and downstream users.

Komakech *et al.* (2012) reported that at Hingili sub-catchment in Tanzania, irrigation water distribution between users has not been enforced by the Government but the WUAs who are using water from a canal. Principles of good neighbourhood that exist between the upstream and downstream users have enabled sustainable water management. This may increase the survival of traditional irrigation schemes.

4.5.3 Conflict Status

It has been found that conflict occurrence varied among the WUAs. In Table 16, a Chi-square test confirmed that there was a highly significant difference among WUAs at $p < 0.001$ level of confidence. This indicates that conflict occurrence is not the same to all WUAs, perhaps due to variation of leadership ability, irrigators' location on a canal, water

user association, strength of institutions, presence of water committee, users and customary laws.

At Fuku WUA, (Table 16) 62.7% of the respondents reported that conflicts have not occurred in their associations. Findings from Fuku canal (Table 17) show that 54.9% of the respondents reported that no conflict has been solved. These findings indicate that conflicts at Fuku were less occurred compared to other WUAs which imply a good chance of irrigation schemes' survival because irrigators could have more time to work together as a team. Conflicts tend to disturb irrigators to concentrate on what should be done to address their challenges especially in ensuring sustainability of their canals, if there are conflicts there would be no room of working together. Conflicts could influence people to do whatever they want, and sometimes to seek for revenge instead of focusing on water resources management.

At Mzinga WUA, (Table 16) it was revealed that 45.9% of the respondents did not experience any conflicts. Furthermore, the findings at Mzinga (Table 17) show that 45.9% of the respondents reported that no conflict has been solved. These findings indicate that Mzinga is experiencing conflicts more or less the same as Fuku. It projects an environment that could enable to create the schemes survive because irrigators would be motivated to take care of their canals effectively than other WUAs which are facing overwhelming conflicts.

Table 16: Chi-square Test on Operationalization of Survival Status

Variable	Indicator	Fuku		Mzinga		Nyamiseta		Mbakana		χ^2	P-value
		n	%	n	%	n	%	n	%		
Conflict occurrence	Mostly occurred	7	13.7	13	35.1	16	66.7	10	35.7	28.16	<0.001
	Less occurred	12	23.6	7	18.9	0	0	10	35.7		
	Not occurred	32	62.7	17	45.9	8	33.3	8	28.6		
	Total	51	100	37	100	24	100	28	100		
Rehabilitation of irrigation infrastructure	Yes	51	100	34	91.9	12	50	24	85.7	88.08	<0.001
	No	0	0	3	8.1	12	50	4	14.3		
	Total	51	100	37	100	24	100	28	100		
Conservation of natural vegetation	Conserved	51	100	37	100	5	20.8	28	100	1.06	<0.001
	Otherwise	0	0	0	0	19	72.9	0	0		
	Total	51	100	37	100	24	100	28	100		

At Nyamiseta WUA, (Table 16) 66.7% of the respondents reported that conflicts had occurred at their association. Also (Table 17) shows that 58.3% reported that conflict has been resolved by users. Nyamiseta is a leading WUA in having conflicts therefore it indicates that the overwhelming conflicts tend to disturb institution of irrigation management which has to be given a close eye by irrigators. Conflicts could jeopardize team work and motivation of each individual to work together so as to rehabilitate their canal and ensuring maintenance in order to keep it function. There will not be any kind of maintenance of traditional canal which would have been made if conflicts were not in existence, as a results the likelihood of survival of those schemes will definitely become less. It was found that Nyamiseta WUA has got no constitution and its institution is weak enough to let things control itself that's why conflicts are happening for a great extent. Even though conflicts were solved by themselves but it was not enough because they happened frequently and it was difficult for members to end conflicts.

At Mbakana WUA, 35.7% of the respondents reported that conflicts have occurred. Table 17 shows that 57.1% reported that conflict has been resolved by WUA leaders. These findings show that Mbakana has been found to be the leading WUA in using their leaders to resolve conflicts, it means that Mbakana had a good chance of ending conflicts and protect water sustainability through engaging more in working as a team due to leaders' efforts.

Table 17: Operationalization of Survival Status (n = 140)

Variable	Indicator	Fuku		Mzinga		Nyamiseta		Mbakana		Total	
		n	%	n	%	n	%	n	%	n	%
Whether and by whom conflict has been solved	WUA leaders	17	33.3	11	29.7	1	4.2	16	57.1	45	32.1
	Ward leaders	3	5.9	2	5.5	0	0	0	0	5	3.6
has been solved	Users of the canal	3	5.9	7	18.9	14	58.3	5	17.9	29	20.7
	No conflict has been solved	28	54.9	17	45.9	9	37.5	7	25	61	43.6
Rehabilitation made	Repair of broken parts	32	62.7	29	78.4	6	25	19	69.7	86	52.1
	Cementing some parts which causes water seepage	19	37.3	8	21.6	0	0	7	25	34	33.6
	No repair has been made	0	0	0	0	18	75	2	7.1	20	14.3
Frequency of rehabilitation which has been made in a year	Not done (0)	0	0	1	2.7	12	50	1	3.6	14	10
	Once (1)	19	37.3	16	43.2	11	45.8	11	39.3	57	40.7
	Twice (2)	15	29.4	16	43.2	1	4.2	11	39.3	43	30.7
	Thrice (3)	17	33.3	4	10.9	0	0	5	17.8	26	18.6
Rehabilitation's enforcement	WUA leaders	51	100	37	100	0	0	28	100	116	82.9
	No enforcement	0	0	0	0	24	17.1	0	0	24	17.1

Also, Nyamiseta WUA seemed to be the leading WUA with conflicts. This is perhaps due to the fact that the Association has weak customary laws to guide the users compared to others. The results indicate that although conflicts have not been the same to all WUAs,

they should not be ignored because they are likely to become detrimental on survival of the schemes. One participant in one of the FGDs reported that:

“..... if peace and harmony had been violated then all WUAs would not have survived and that could also have compromised the survival of the canals. Therefore, we should be anxious to address conflicts in the near future so as to consolidate our WUA and working together as one because conflicts creates selfishness and destroy solidarity”.

It was found that conflicts were solved at different levels and institutions have played its role to rectify the conflict which had happened, water committee has been taking its role in solving and preventing conflicts. However, the level of conflict determined how it could be solved, if it is extremely frightening then the local government had to take its role. Gutu *et al.* (2014) reported that, conflicts at local level has been resolved at different levels depending on their magnitude. If there is a minor conflict then one to one negotiation between victims is done. Moderate conflict has been resolved by the water committee responsible for water distribution and chronic conflict has been resolved by local government office.

It was revealed that conflict at Nyandira were not only caused by irrigation scheduling and water distribution but also due to water shortage when irrigators needed it the most. Because schemes have not been cemented it caused a substantial water seepage into the ground therefore the downstream users were sometimes getting less water when it comes to irrigation scheduling. However, Mbonile (2005) in the Pangani River Basin, Northern East of Tanzania, reported that intensive water conflicts among beneficiaries can be avoided through rehabilitation of irrigation infrastructure. This is because it prevents excessive wastage of water that seeps into the ground.

4.5.4 Conservation of Natural Vegetation along Canals

Informal institutional set up influenced the conservation of natural vegetation along the canal because it started from the Wami/Ruvu Basin who ordered local government authorities to be keen on taking a good care of schemes. The local government gave orders to the WUAs to ensure they keep a close eye whose supervision has been made by leaders who implement what has to be done by enforcing rules and penalize irrigators who go against the rules which had been set. Table 16, shows that conservation of natural vegetation along the canals has been done. A hundred percent of the respondents from Fuku reported that they conserved the natural vegetation along their canal. Seventy two point nine percent of the respondents from Nyamiseta reported that they did not conserve the natural vegetation along the canals probably because of having weak customary laws. Since majority have been conserving the natural vegetation along canals it indicates that the canals have increased a substantial amount of water which otherwise would have been seeping into the ground and enables the rise of water flow in the canals. A Chi-square test shows that there was highly significant difference among the WUAs at the $p < 0.001$ level of confidence. The results indicate that Nyamiseta has compromised its survival because of being irresponsible in conserving the natural vegetation along their canals, which could reduce a lot of water which may seep into the ground. It was revealed that conservation of natural vegetation along the canal could also attract water availability and rainfall in the schemes. Similar findings reported by Machibya and Mdemu (2005) who conducted a study in the Usangu Plains Tanzania, described that institutions have enabled the conservation of natural vegetation along canals because of a strong monitoring and enforcement of rules so as to enable water saving, conservation of natural vegetation along the canal lubricates water flow and prevents water seepage and reduction.

4.5.5 Rehabilitation of Irrigation Infrastructures

According to Kurian (2004). The stronger the institution the higher the level of rehabilitation of irrigation infrastructure. Because if the institution is strong it means it is likely to be strict in implementing rules and execute those who go against it. It was revealed that strong institution has to be the institution which was the best in enforcing its rules while irrigators were the best in abiding to the rules and regulation. The dependent variable, ‘survival of traditional irrigation schemes’ which was measured by the indicator rehabilitation of irrigation infrastructure shows a significant implication to the survival of traditional irrigation schemes in the study area. Table 16, shows that 100% of the respondents from Fuku reported that rehabilitation of irrigation infrastructure has been done. Since majority have rehabilitated the irrigation infrastructure, it indicates the survival of traditional irrigation schemes in the study area. This was possible because of the institutional set up which existed at Nyandira. Rules, regulation and governance of traditional irrigation schemes has enabled canals to function effectively throughout a year. However, it was revealed that the response was not the same among the WUAs. The Chi-square test confirmed that there were a highly significant difference at the $p < 0.001$ level of confidence. The findings further imply that the survival status of Nyamiseta WUA is endangered because it mainly depends on seasonal water channels which have been reducing water depth day after day because those channels are not rehabilitated. Furthermore, Nyamiseta has been operating its WUAs without a written constitution or water committee and those who did not abide to their regulations were mostly warned than being punished.

It was observed that rehabilitation of canals by WUAs depends on the nature of the canal itself and the demand encountered at that time. Table 17, shows that 52.1% of the respondents reported that they have repaired their canals especially on the most broken

parts. Thirty three point six percent reported that they have rehabilitated their canals by concrete lining in some parts in those areas due to serious seepage. These results tell us that Nyamiseta has been the least Association in rehabilitating its canals. This indicates a risk of sustainability of the irrigation system. Because Nyamiseta has got a weak institution and has been operated without a water committee and constitution then it is very difficult to organise people when maintenance work has to be done, therefore, the weak institution at Nyamiseta could not intimidate people to accept devoting their time as a team on rehabilitation or whatever as everything is being done individually while maintenance or rehabilitation of canal is not done at all which results to a risk of its survival.

During the survey, the frequency of canal rehabilitation was captured so as to assess the extent of irrigators' involvement as a mechanism of ensuring the survival of traditional irrigation schemes. Table 17, reveals that 40.7% reported that their canal has been rehabilitated once a year. These results show that Fuku is the leading WUA towards rehabilitation of its canals while Nyamiseta is the least. Hence Fuku is the best and its survival status is high unlike Nyamiseta which is the poorest. Literally, Fuku has strong institutions that were characterised by solid enforcement of rules and regulations which guided the water users on good governance of their WUAs. Fuku had administrative structures with constitutions and water committees which acted as the main decision maker. If a person failed to abide to the rules and regulations he/she was punished according to the constitution.

It was important to assess whether the rehabilitation of the irrigation infrastructure has been enforced or not. This was done so as to evaluate the extent to which a certain association could do the rehabilitation. Table 17, shows that 17.1% of the respondents from Nyamiseta reported that the enforcement on rehabilitation of canals has not been done lately. These

findings, perhaps provide an insight as to why Nyamiseta has been the least WUA to rehabilitate its canal. If enforcement had been done at Nyamiseta, the rehabilitation of irrigation infrastructure would have been taken seriously. There is a risk of Nyamiseta canals to perish because it has been abandoned and nobody cares about it. Similar findings have been reported by Fanadzo (2012), who conducted his study in Zanyokwe irrigation scheme in South Africa. He found that irrigation schemes that are neither maintained nor rehabilitated are likely to face the problem of sustainability and viewed as a major cause of poor performance in traditional irrigation scheme. He mentioned that strong institution could enable good functioning of canals and WUAs that would influence good governance, rehabilitation and maintenance of the canals. One key informant reported that:

“Nyamiseta has been the least performing association among all WUAs in Nyandira because it does not have a strong institution to govern it because we don’t have a water committee nor constitutions and bad enough is that no punishments are provided to those who fail to abide against rules and regulations. The users are doing whatever they want. I guess the canal will not survive in the next two years”.

According to Blomquist *et al.* (2004), institutions have facilitated the ease with which multiple actors interact in complex situations, prescribing what actions are allowed, required, or forbidden in given situations. It has governed water use, rehabilitation, and determined, when, and how water management should be. A similar situation is happening in the study area. Institutions have made the canals in Nyandira to be in existence because water users have been obeying rules and regulations which were set by them for operation and maintenance of the systems.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In view of the findings of this study, the following conclusions are made:

- (i) Five factors were found to be statistically significant in influencing survival of traditional irrigation schemes. These factors were enforcement of water payment fees, water committee, rules on water distribution between upstream and downstream, land ownership and users conformity to rules and regulations.
- (ii) Gender relations among the irrigators were found to be practised jointly by males and females of all age. These were shown in access to and control over resources as well as activity profile which captured farm and irrigation activities.
- (iii) Irrigators have a positive attitude towards contribution of water permit systems for the survival of traditional irrigation schemes. However, dissemination of information about the significance of water permits to non-members have been a challenge as most of them were less informed. Therefore, the attitude between members and non-members on water permit differed significantly.
- (iv) Conflicts were experienced differently among the WUAs: For example Fuku had less water conflicts compared to Nyamiseta due to its weak institution.
- (v) There is a missing linkage on the institutional set-up, the WUAs are mostly depending on themselves while they should have been helped by the Basin office or local government.

- (vi) Water was fairly distributed between upstream and downstream users according to the rotational schedule. However, the upstream users seemed to face less stress on water distribution compared to the downstream users because they were abstracting water illegally on the upstream areas.
- (vii) Rehabilitation of irrigation infrastructure and conservation of natural vegetation along canals has been done by all WUAs. However, this differed depending on the strength of their institution.
- (viii) Village and Ward Governments paid less attention to the WUAs. They lacked expertise in the irrigation issues and most of the technical matters has been done based on indigenous skills.

5.2 Recommendations

In view of the above conclusions, the following are recommendations derived from the study will enhance the survival of traditional irrigation schemes in Nyandira Ward Tanzania:

- (i) All WUAs in Nyandira must be registered.
- (ii) The Government/NGOs must support WUAs financially/technically to strengthen their irrigation activities.
- (iii) WUAs must apply for water permits.
- (iv) Government and NGOs must give financial and technical support to the non-registered WUAs so as to give them a chance to maintain their canals.

- (v) Capacity building from Government/NGOs to irrigators' leaders is a necessity at Village and Ward levels. This will ensure sustainability of traditional irrigation schemes.
- (vi) The study recommends further research in the area of the influence of socio-economic factors influencing the sustainability of traditional irrigation schemes in Tanzania.
- (vii) Investigation on the perception of Local Government to support the governance of WUAs in Rural Tanzania, is also recommended.

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APPENDICES

Appendix 1: Household Survey Questionnaire

INSTRUCTIONS:

Fill in the blank for correct answer OR tick/circle once for the correct answer.

GENERAL INFORMATION

Name of interviewee	
Name of water user association	
Location along canal H/T	
Name of village	
Name of ward	
Date of interview	
Cell phone of Interviewee	

A. BACKGROUND INFORMATION

1. Age of respondent _____
2. Sex of respondent (1) Male (2) Female
3. Marital status
 (1) Married (2) Single (3) Divorced (4) Widowed
4. Household size (Number of persons) _____
5. Household composition
 (1) Male headed household (2) Female headed household (de facto – de jure)
6. Education level of household head
 (1) Illiterate (2) Adult education (3) Primary education (4) Secondary education (5)
 College/University education (6) Other (specify) _____
7. a) How many plots do you have? _____
 b) If there is a spouse: How many plots does your spouse have? _____

8. a) How did you acquire your four largest plots?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
- b) If there is a spouse: How did your spouse acquire the four largest plots?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
9. a) How many acres do you have for the four largest plots?
 1) Plot 1 ____ 2) Plot 2 ____ 3) Plot 3 ____ 4) Plot 4 ____
- b) How many acres cultivated? _____
- c) If there is a spouse: How many acres do you have for the four largest plots?
 Plot ____ 2) Plot 2 ____ 3) Plot 3 _____ 4) Plot 4 _____
- d) How many acres cultivated? _____
10. a) Which plots are irrigated?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
- b) If irrigated, by which canal?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
- c) Which WUA does the irrigated plot belong? _____
- d) If there is a spouse: Which plots are irrigated? _____
- 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
- e) If irrigated, by which canal?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____
- f) Which WUA does the irrigated plot belong?
 1) Plot 1 _____ 2) Plot 2 _____ 3) Plot 3 _____ 4) Plot 4 _____

**B. INSTITUTIONAL FACTORS THAT GOVERN TRADITIONAL
IRRIGATION SCHEMES IN NYADIRA
MAINTANANCE**

11. Have you ever irrigate your plot with the canal? _____
12. If yes, are you still irrigating? _____
13. If no, why not? _____
14. Would you like to irrigate in the future? Explain _____
15. a) What are the rules on repair and maintenance of traditional canal in your association? _____
- b) Who has to participate? _____
- c) By when do they have to do? _____
- d) What are the rules if one does not obey the rules on repair and maintenance of the canal? _____
- e) Do you think the rules are (1) Adequate (2) Satisfactory (3) Inadequate
- f) If inadequate, what do you see as a solution? _____
16. a) Are the rules enforced? 1) Adequate 2) Otherwise
- b) If not, why? _____
- c) Have people who don't obey has been punished? 1) Yes 2) No
- d) Do you think the enforcement is (1) Adequate (2) Satisfactory (3) Inadequate
- e) If inadequate, what do you see as solutions? _____

WATER MANAGEMENT

17. What is the water distribution status between upstream and downstream?
- (1) Fair (2) Unfair
- Clarify _____

18. a) Are there any water use conflicts occurred in your association?
 (1) Yes (2) No
- b) How do you grade conflict 1) Mostly occurred 2) Less occurred 3) Not occurred
- c) If yes, how does the conflict solved? _____
19. If yes, has there been any campaign on conflict prevention between upstream and downstream along the same stream especially on water distribution?
 1) Yes 2) No
20. If yes, how do you grade the campaign on water conflict prevention to the beneficiaries in your association?
 (1) Adequate (2) Otherwise
21. a) Do you have the tendency of conserving natural vegetation along the canal?
 (1) Conserved (2) Otherwise
- b) If yes, how often? _____
- c) Who enforces? _____
22. a) What can you say about the by-laws that are guiding your WUA on water distribution
- i. In allocating the water within the canal? _____
- ii. In distributing the water within the canal? _____
- b) How do the rules ensure that the tail enders get sufficient water? _____
- c) Do you think the rules are (1) Strong (2) Satisfactory (3) Very poor
- d) Are the rules implemented/enforced? 1) Yes 2) No
- e) To what extent users conform rules and by-laws
 (1) Good (2) Bad
- f) If no, why? _____
- g) If yes, give example of its enforcement _____
- h) Do you think the implementation/enforced is

(1) Very strong (2) Satisfactory (3) poor

i) If it's poor what are your suggestions? _____

23. a) From which water source do you take water?

1) Irrigation _____ 2) Drinking water _____

3) Other domestic uses _____ 4) Cattle watering _____

5) Other uses (specify) _____

b) Do you have any rules to avoid taking water by non-members?

1) Yes 2) No

c) If yes, which rule (give examples of its enforcement)

c) If no, why not? _____

d) Do you have any rules to protect water from the intake? 1) Yes 2) No

e) If yes, which rule (give examples of its enforcement)

f) If no, why not?

24. a) Have you ever attended any workshop or training on water management in irrigation issues? (1) Yes (2) No

b) If yes, which training? _____

c) What was the topic(s)? _____

d) Do you think the learning and discussion on the topics was

(1) Very adequate (2) Satisfactory (3) Inadequate

25. a) Do you have people who ensure the security of the canal?

b) If yes, how do you grade 1) Strong 2) Weak

c) If weak, what measures do you take? _____

PAYMENT

26. Since when do you use water from the canal? _____
27. Since when do you pay for water from the WUA? _____
28. How much do you pay for maintenance? _____
29. To whom do you pay? _____
30. What service do you get? _____
31. Is the water distribution the same as for members or less? _____
32. Do you attend meetings of the WUA? _____
33. Are you satisfied with the service for which you pay? _____
34. If canal passes through land: how does the WUA compensate for the canal passing through/along your land? _____
35. How did you decide to pay for water? _____
36. Did you try to become a member? Explain _____
37. What happens if you don't have the money to pay? _____
38. Do you know non-members who take water without paying? _____
39. Are WUA members happy with having the current paying non-members?

40. Would the WUA want more expand the number of non-members? _____
41. a) What are the rules on fee payment of traditional canal in your association?
- b) Who has to pay? _____
- c) By when do they have to do? _____
- d) What are the rules if one does not obey the rules on payment? _____
- e) Do you think the rules are (1) Adequate (2) Satisfactory (3) Inadequate
- f) If inadequate, what do you see as a solution? _____

42. a) Are the rules for payment enforced? 1) Yes 2) No
- b) If not, why? _____
- c) Have people who don't obey been punished? 1) Yes 2) No
- d) Do you think the enforcement is
- (1) Very adequate (2) Satisfactory (3) Inadequate
- e) If inadequate, what do you see as solutions? _____
43. a) Who is on the water committee (gender) _____
- b) What are their obligations?
- i. Chair _____
- ii. Secretary _____
- iii. Treasurer _____
- iv. Security person _____
- v. Water distributor _____
- c) What are the characteristics and skills of committee members?
- i _____ ii _____ iii _____ iv _____
- d) How does one become a committee member? 1) Election 2) Appointed
- e) If elected, for how many years are committee members elected? _____
- f) When was the last election? _____
- g) How is the current committee performing on repair and maintenance in your view? _____
- h) If there are problems, how can they be solved? _____
- i) How is the current committee performing on water distribution _____
- j) If there are problems, how can they be solved? _____
44. a) What are the obligations of the
- i. Chair _____

- ii. Secretary _____
 - iii. Treasurer _____
 - iv. Security person _____
 - v. Water distributor _____
- b) Do the current committee fulfil those roles 1) Good 2) Otherwise
- c) If fair or bad, what do you see as solutions? _____
- d) What can you do to hold them accountable? _____
- e) Do male committee members fulfil their obligations usually better or worse than female committee members? Why?

D. GENDER RELATIONS AMONG ACTORS IN THE STUDY AREA

45. Gender relations in irrigation issues; who does the work?

Activities	M	W	B
Farm preparation			
Cultivation			
Irrigation			
Harvesting			
Selling			
Budgeting			
Fetching water			
Rehabilitation of canal			
Conflict resolution			
Water distribution			
Fee collection			
Security of canal			

Access & Control Profile	Access	Control
Farm equipment		
-Hand hoe		
-Panga		
Irrigation equipment		
-Pumps		
-Pipeline water supply		
-Canal water		
Decision Making		
Benefits		
Land		

Key: 1= Mostly Young Male, 2 = Young Male only, 3 = Mostly Young Female, 4 = Young Female only, 5 = Mostly Adult Male, 6 = Adult Male only 7 = Mostly Adult Female, 8 = Adult Female only, 9 = Mostly Old Male, 10= Old Male only, 11 = Mostly Old Female, 12 = Old Female only, 13= Male leaders, 14 = Female leaders, 15 = All leaders, 16 = All genders

46. a) What are the conditions for becoming a member

i. During the construction of a canal _____

ii. After the canal has been built? _____

b) Is it easier for young male, young female, adult male, adult female, old male or old female to become a member? _____

c) Why? _____

47. a) What is your view on the current paying non-members? _____

b) What is your view on the future: should there be more paying non-members?

E. ATTITUDE OF IRRIGATORS TOWARDS THE WATER PERMITS

PART I: POSITIVE STATEMENTS

48. A valid water permit can prevent land grabbing from big investors?

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

49. Having a water permit can solve the water use conflict between upstream and downstream users between canals along the same stream?

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

50. A valid water permit to water user associations is the key for the survival of the traditional canals?

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

51. Water permit should be vested in the ward level so that all people in the ward will be benefited

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

52. Water permit should be vested to the WUA so as to benefit the members only

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

53. Water permit increases the morale to work, accountability and commitment of the owners to water conservation and security

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

PART II: NEGATIVE STATEMENTS

54. Most of the members in your association don't have enough knowledge on a water permit

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

55. Most irrigator's associations don't have a water permit because it is very expensive to pay for the permit annually?

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

56. Running a water user association without a valid water permit is illegal

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

57. Water permit is a threat in creating classes of haves and have not in the same area thus exploitation will be inevitable

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

58. Having a permit is a condition for the government's assistance

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

59. WUA's leaders are less concerned in making follow up on water permit and they don't know even the price

(1) Strong disagree (2) Disagree (3) Neutral (4) Agree (5) Strong agree

F. SURVIVAL STATUS OF TRADITIONAL IRRIGATION SCHEMES

60. What is the annual cost spent in rehabilitation of canal?

Appendix 2: Household Survey Questionnaire for Tap Water System Users

INSTRUCTIONS:

Fill in the blank for correct answer OR tick/circle once for the correct answer.

A. GENERAL INFORMATION

Name of interviewee	
Standpipe number/HSD connection	
Location along pipe line H T	
Date of interview	
Cell phone of Interviewee	

B. BACKGROUND INFORMATION

1. Age of respondent _____
2. Sex of respondent (1) Male (2) Female
3. Marital status
(1) Married (2) Single (3) Divorced (4) Widowed (5) Other (specify) _____
4. Household size (Number of persons) _____
 - 1) Members below 5 years _____
 - 2) Members of age between 6 and 18 years _____
 - 3) Members of age between 19 years and above _____
5. Household composition
(1) Male headed household (2) Female headed household (de facto – de jure)
6. Education level of household head
(1) Illiterate (2) Adult education (3) Primary education (4) Secondary education
(5) College/University education (6) Other (specify) _____

C. WATER USES

7. How many plots does your household have? _____
8. How many plots are irrigated? _____
9. From which water sources do you take water when it is raining?
- 1) Irrigation _____ 2) Drinking water _____
- 3) Other domestic uses _____ 4) Cattle watering _____
- 5) Other uses (specify) _____
10. a) From which water sources do you take water when there are dry spells in the rainy season?
- 1) Irrigation (specify canal/WUA) _____ 2) Drinking water _____
- 3) Other domestic uses _____ 4) Cattle watering _____
- 5) Other uses (specify) _____
11. From which water sources do you take water in June – September?
- 1) Irrigation _____ 2) Drinking water _____
- 3) Other domestic uses _____ 4) Cattle watering _____
- 5) Other uses (specify) _____
12. What do you pay for water from a standpoint / household connection per unit of time/volume for domestic uses? _____
13. For household connections: how much did you pay for your household connection? _____
14. Who in the household pays for water for domestic uses? (Exclusive men/mostly men/ half-half/mostly women/ exclusively women)
- _____
15. If water is used for irrigation: how much do you pay? _____
16. Who in the household pays for water for irrigation? (Exclusive men/mostly men/ half-half/mostly women/ exclusively women)
- _____

17. a) What are the rules if one does not obey the rules on payment?

b) Do you think the rules are (1) Adequate (2) Satisfactory (3) Inadequate

c) If inadequate, what do you see as a solution? _____

18. a) Are the rules for payment enforced? 1) Yes 2) No

b) If not, why? _____

c) Have people who don't obey been punished? 1) Yes 2) No

d) Do you think the enforcement is

(1) Very adequate (2) Satisfactory (3) Inadequate

e) If inadequate, what do you see as solutions? _____

19. a) Who is in the pipeline committee (gender) _____

b) What are their obligations?

i. Chair _____

ii. Secretary _____

iii. Treasurer _____

iv. Security person _____

v. Water distributor _____

c) What are the characteristics and skills of committee members?

i _____ ii _____ iii _____ iv _____

d) How does one become a committee member? 1) Election 2) Appointed

e) If elected, for how many years are committee members elected? _____

f) When was the last election? _____

g) How is the current committee performing on repair and maintenance in your view? _____

d) If there are problems, how can they be solved? _____

e) How is the current committee performing on water distribution _____

- f) If there are problems, how can they be solved? _____
- g) Do male committee members fulfil their obligations usually better or worse than female committee members?
- h) Why? _____
20. a) Who owns the pipe? _____
- b) Who owns the water in the pipe? _____
- c) How is the ownership of the water created? _____
- d) Do you agree with the way in which ownership was created? _____

D. WATER CONFLICTS DOMESTIC – IRRIGATION USES

21. If people irrigate now, is there still enough water for everybody's domestic uses? _____
22. Is there enough water so that more people start irrigating in the future?

23. If water is scarce, how is the priorities between the different uses and users set?

24. Is that prioritization enforced? If not, why not? _____

-THANK YOU VERY MUCH FOR YOUR COOPERATION-

Appendix 3: Checklist Guide for Interview with Ward Leaders

1. How do you ensure the enforcement of by-laws that created by water user association?
2. How do you engage in conflict resolution especially on upstream and downstream users?
3. How do you ensure the improvement of irrigation infrastructures along and within the canal?
4. What strategies have you set to ensure the management and maintenance of canals?
5. Does the WUA have water permit? If no, why?
6. If yes, was it vested to the whole village or WUA?
7. What are the most constraining factors that hinder the development of traditional irrigation schemes?

Appendix 4: Checklist Guide for Interview with Village Leaders

1. Do you recognize the existence and operation of WUA in your village?
2. If yes, do you know the total number of WUA by names?
3. How do you support the operation of WUA?
4. Do you have any strategies to ensure the survival of traditional irrigation schemes in the village?
5. How do you help WUA with conflict resolution?
6. How do you ensure gender equality and equity in the WUA?
7. Have you received any complaints concerning water allocation and distribution? If yes, how did you sort out?

Appendix 5: Checklist Guide for Interview with WUA Leaders

1. Do you have written or oral by-laws for guiding your association? If so, who formulated it? Who enforces the rules?
2. How many times in a year does the management of the canals meet? What do you discuss?
3. Do you involve non-irrigator's association members as well?
4. Who writes and keeps the record of all the association?
5. Is there any penalty for not attending the meeting? If not, what do you do if a member has not attended?
6. Have you registered your WUA? If yes, when and where? If no, why?
7. Who is eligible of being a normal member, temporary member or founding member? Who decides on membership?
8. Are members of WUA aware of rules and regulation? If yes, do they obey? If no how do you punish them?
9. How do you consider gender roles in your association? What roles do men and women play?
10. What is the survival status of tradition irrigation schemes in Nyandira?

Appendix 6: Checklist Guide for Interview with Extension Officer

1. Are you aware of water user association in your area?
2. What technical part needs to be intervened?
3. What technical advice have you provided to the WUA?
4. How do you rate the performance of these WUA recently in your working area?
5. How will you foresee the survival status of WUA in the near future?

Appendix 7: Interview Guide for Focus Group Discussion

1. When was the canal established? Who initiated? How were people organized for the construction work?
2. How often does water use conflict occur? Why? How do you solve?
3. How water is distributed among various users? Is there any group or individuals who have more power or rights to use irrigation water than others? Why?
4. How do you assess the water flow trend in the canal since the establishment of your association?
5. If an emergency occurs, for example overflow of water in the canal, how are the people informed? Who is deciding on what repairs to be made?
6. Are women involved in both the routine and emergency maintenance?
7. Are there other schemes or projects using water from the same source? Do they have water permit?
8. What are the attitudes of irrigator's towards water permits and survival of traditional canals?
9. What do you say about the property right creation in constructions of the canal?
10. Do you have strategies to ensure survival of traditional irrigation schemes in Nyandira?