

**A COMPARATIVE ASSESMENT OF PERFORMANCE OF PRIVATE AND
COOPERATIVE INSTITUTIONAL ARRANGEMENTS OF IRRIGATION
SCHEMES: CASE STUDY OF MBARALI DISTRICT, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
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ABSTRACT

The study to compare performance of private and cooperative institutional arrangements of irrigation schemes was conducted in Mbarali District. Two irrigation schemes; Igomero cooperative institution scheme and Mbarali Estate private institution scheme were compared. The study was directed by a hypothesis that there is no difference in performance of irrigation schemes under each institutional arrangement. Both primary and secondary data were collected and then analysed using regression, gross margin and returns on investments to establishing if there is any significance difference between the two institutional arrangements. Scheme performance was captured based on physical, institutional and economic ratio factors. Statistical results showed that there were significant performance differences between private and cooperative irrigation schemes based on factors mentioned above. Overall the performance of cooperative irrigation scheme was found better by scoring 84.11% as compared to privately managed irrigation scheme which scored 78.45%. In physical factors, private company scored 36.11% compared to cooperative scheme scored 33.69%. In economic factors cooperative scheme scored 37.28% while private scheme scored 30.13% and in institutional factors cooperative irrigation scheme performed better by scoring 8.64% while private scheme scored 7.64%. Based on the findings of this study, the following is recommended: irrigators from private irrigation scheme should form organisation which will present their need to the management, irrigators are also to be allowed to plant their crops early so as to fetch better prices in early season contrary the current prevailing bylaw of waiting the investor to plant first. Cooperative scheme should find better ways to collect revenues from farmers on time hence sustainability of their scheme and finally all irrigation schemes should employ extension workers.

DECLARATION

I, Fanuel Isaya Sirikwa, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work, completed within the period of registration and that it has neither been submitted nor being concurrently submitted in any other Institution.

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The above declaration is confirmed

Prof. Joseph Phillip Hella

(Supervisor)

Date

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TABLE OF CONTENTS

ABSTRACT.....	ii
DECLARATION.....	iii
COPY RIGHT	iv
ACKNOWLEDGEMENTS	v
DEDICATION.....	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF APPENDICES	xiv
LIST OF ACRONMY AND ABBREVIATIONS	xv
CHAPTER ONE	1
1.0 INTRODUCTION	1
1.1 Background Information	1
1.1.1 Tanzania agriculture and irrigation information	1
1.1.2 Irrigation institutions characteristics	2
1.1.3 Institutions governing irrigation and their responsibilities in Tanzania.....	2
1.2 Irrigation Institutions Under this Study	3
1.3 Problem Statement and Justification	4
1.4 Study Objectives.....	6
1.4.1 Overall objective	6
1.4.2 Specific objectives.....	6
1.4.3 Research hypothesises.....	6
1.5 Organisation of Dissertation.....	7

CHAPTER TWO	8
2.0 LITERATURE REVIEW	8
2.1 Irrigation Overview	8
2.2 Irrigation Institutional Arrangements	8
2.3 Tanzania Irrigation Institutions.....	11
2.3.1 National level	11
2.3.2 Zonal level.....	12
2.3.3 Local Government Authorities.....	13
2.3.4 Irrigators organisations.....	14
2.3.5 Private sector	14
2.3.6 Farmers/Irrigators.....	15
2.3.7 Non-Governmental Organisations (NGOs).....	16
2.4 Tanzania Policies and Legislation	16
2.5 Relationship between Central Government, Regional and Local Governments, and Social Actors in Water Governance.....	18
2.6 Institutional Limitations	19
2.7 Performance of Irrigation Scheme	20
2.7.1 Performance of Management, Operation and Maintenance (MOM) for different institutional arrangements of scheme management.....	22
2.7.2 Production and productivity in irrigated agriculture	25
2.7.3 Other studies on irrigation performance with respect to institutions arrangements	26

CHAPTER THREE	29
3.0 METHODOLOGY	30
3.1 Description of the Study Area	30
3.2 Data Source and Collection Methods	32
3.2.1 Data sources and types	32
3.2.1.1 Primary data	32
3.2.1.2 Secondary data	32
3.2.2 Methods of data collection.....	33
3.2.2.1 Field visits	33
3.2.2.2 Key informants	33
3.2.2.3 Survey.....	33
3.3 Sampling Method and Sample Size	33
3.4 Conceptual Framework	34
3.5 Data Analysis	37
3.5.1 Study of organisational and institutional factors versus irrigation performance using linear regression	37
3.5.2 Production and returns to investment analysis.....	38
3.5.3 Irrigation institutional performance model	41
3.5.4 Limitation of the methodology.....	45
CHAPTER FOUR	46
4.0 RESULTS AND DISCUSSION	46
4.1 Characteristics of the Population, Organisation and Institutional	46
4.1.1 Social economic characteristics of study population.....	46
4.1.2 Institutional and organizational arrangements of irrigation water management.....	47

4.1.3	Cooperative and private scheme institutional performance	49
4.2	Paddy Production Returns on Investment in Different Irrigation Schemes	53
4.3	Effect of Institutional Arrangement on Performance of Scheme	55
CHAPTER FIVE		59
5.0	CONCLUSION AND RECOMMENDATION.....	59
5.1	Conclusion.....	59
5.3	Recommendations	62
REFERENCES.....		64
APPENDICES.....		71

LIST OF TABLES

Table 1:	MOM physical performance indicators, formulation, and data specifications.....	23
Table 2:	MOM economical performance Indicators, formulation, and data specifications.....	24
Table 3:	MOM institutional performance indicators, formulation, and data specifications.....	25
Table 4:	Other studies on irrigation performance for water user association institutional arrangements	27
Table 5:	Other studies on irrigation performance for Private irrigation scheme institutional arrangements	28
Table 6:	Methods for determining the mark and weight of physical factors	43
Table 7:	Methods for determining the mark and weight of economic factors	44
Table 8:	Methods for determining the mark and weight of institutional factors.....	44
Table 9:	Social economic characteristics	46
Table 10:	Anova table showing significance level of the model and power of independent variables in expressing the depending variable	50
Table 11:	Showing coefficient of various variables used in determining institutional performance and their significance	51
Table 12:	Average cost and revenue of paddy per acre	53
Table 13:	MOM physical indicators scores.....	55
Table 14:	MOM economical indicators scores	56
Table 15:	MOM institutional indicators scores.....	57

LIST OF FIGURES

Figure 1: Interlinkages among Water Institutional Components.....	9
Figure 2: Conceptual diagram illustrating the linkages among the central government, regional and local governments, and Social actors in water governance.	19
Figure 3: Nested institutions and management performance	21
Figure 4: Location of irrigation schemes under this study	31
Figure 5: Presents modified institutional analysis and development framework.....	35
Figure 6: Igomero irrigation scheme organizational structure distribution of tasks structure (Bottom- up).....	48
Figure 7: Mbarali Estate organisational structure and distribution of tasks structure (Top-Down)	49

LIST OF APPENDICES

Appendix 1: Questionnaires	71
Appendix 2: Checklist.....	74
Appendix 3: Weighted average marks formula and calculations.....	76
Appendix 4: Finding for objective 2 and 3	80

LIST OF ACRONYM AND ABBREVIATIONS

CPRs	Common Property Resources
CWB	Central Water Board
DALDOs	District Agriculture and Livestock Development Officers
DEDs	District Executive Directors
ESRF	Economic and Social Research Foundation
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
GI	Gross income obtained by crop
ha	Hectare
Ho	Null hypothesis
IMT	Irrigation Management Transfer
IO	Irrigators Organisations
IS	Irrigation Section
IWMI	International Water management Institute
kg	Kilogram
LGAs	Local Government Authorities
Ln	Natural logarithm
Ltd	Limited company
m.	Metre
MAFS	Ministry of Agriculture, Food Security and Cooperatives
MDC	Mbarali District Council
MIP	Mbarali Investment Profile
mm	Millimetre
MOM	Management, Operation and Maintenance

MoWI	Tanzania Ministry of Water and Irrigation
MTNRE	Ministry of Tourism, Natural Resources and Environment
NAFCO	National agricultural and Food Corporation
NAP	National Agriculture Policy
NEMC	National Environmental Management Council
NGOs	Non-Governmental Organizations
P	Probability
PIM	Participatory Irrigation Management
pop	Population
RLDC	Rural Livelihood Development Company
ROI	Return on Investment
SACCOS	Savings and Credit Cooperatives Societies
SUA	Sokoine University of Agriculture
TAFSIP	Tanzania Agriculture and Food Security Investment Plan
TMAFS	Tanzania Ministry of Agriculture and Food Security.
TNIP	Tanzania National Irrigation Plan
Tsh.	Tanzanian Shillings
URT	United Republic of Tanzania
VEO	Village Executive Officer
WAM	Weight Average Marks
WUA	Water Users Association
ZIU	Zonal Irrigation Unit

CHAPTER ONE

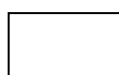
1.0 INTRODUCTION

1.1 Background Information

1.1.1 Tanzania agriculture and irrigation information

The agriculture sector in Tanzania account for 26.5% in 2010 for Tanzania's GDP, and engages 80% of the labour force (ESRF, 2012). Despite of its importance, agriculture is affected by seasonality and unreliability of rainfall and periodic droughts. It is for this reason that irrigation is considered necessary for providing protection against drought, a means of stabilising crop production and assurance of household food security (MoWI, 2009). Potential land for irrigation in Tanzania is 29.4 million hectares, with 2.3 million hectares classified as high potential, 4.8 million hectares as medium potential and 22.3 million hectares as low potential (URT, 2011). Furthermore, URT (2011) reports has found that only 331 490 hectares have been provided with improved irrigation infrastructure as of May 2010.

In Tanzania most of the irrigated areas used by smallholders are under surface irrigation. Historically, the lack of adequate finance has resulted in inadequate system operation and maintenance. This has caused many irrigation systems to be built with inadequate control structures and in many cases, no facilities for drainage. The result has been projects that decline rapidly in their ability to provide adequate and timely water delivery (MoWI, 2009).



1.1.2 Irrigation institutions characteristics

Institutional arrangement in irrigation refers to a set of rules or agreements governing the activities of a specific group of people pursuing irrigation activities. Institutions can also be explained as “entities defined by a configuration of legal, policy, and organizational rules, conventions, and practices that are structurally linked and operationally embedded within a well-specified environment (Saleth and Dinar, 2004).

The key characteristics of institutions includes rule of law, participation of stakeholders, transparency, responsiveness, consensus-oriented, accountability, equity and inclusiveness, effectiveness and efficiency (Andrew and Were, 2009).

The study mainly involves institutions from the district to individual irrigator’s levels. These includes district agriculture and irrigation departments, Non government organisations, and private companies involved in irrigation, water authority, water users associations and water users. Institutions aim at setting principles for allocating water to existing and prospective users; enable the public to participate in managing the water resources; ensuring accommodation of the needs and expectations of existing and potential water users. They should be developmental in nature while ensuring the sustainable use of water resources in their area of operation (Karar, 2004).

1.1.3 Institutions governing irrigation and their responsibilities in Tanzania

At the national level, the Ministry of Agriculture, food security and cooperatives is the agency responsible for overall water policy setting, coordination, monitoring, evaluation and regulating community water supplies. The ministry enforces laws and regulations for water quality, issuance and regulation of water rights, enforce water and effluent

discharge laws as per standards as well as conducting research and development of irrigation sectors.

The ministry's activities on irrigation are also facilitated by Water Basin Authorities, Zonal Irrigation Units and Agriculture research centres. Decentralisation in the Tanzanian water and irrigation sector has transferred responsibilities for service provision to Local Government Authorities (LGAs). LGAs are responsible for the procurement, financing, management and monitoring of service water providers in their respective administrative area. Water user associations and private water companies are responsible for administration, management and operations of the irrigation scheme as well as putting attention on the sustainability of irrigation water, distribution of water, collecting funds and financing the irrigation scheme. National and local Non Government Organisations participating in irrigation acts as watchdogs in various activities taking place in the field and among irrigation stakeholders. They also initiate dialogue on the irrigation sector, economic, social and environment concerns among stakeholders (MoWI, 2010).

This study looked at cooperative and private water institutions, how far they have reached them, and what remains to be done, what are the challenges they are facing as well as the contribution of the respective institution function/target on respective performance attained.

1.2 Irrigation Institutions Under this Study

According to MoWI (2009) Tanzania government has withdrawn from direct management, operation and maintenance of irrigation schemes. The later scheme activities and ownership were transferred to either beneficiaries or to private sector. Based on the nature of the study objectives, this study was to look for the institutional

arrangements in three types of irrigation scheme which are Government owned, privately owned and irrigators owned irrigation schemes, but due to privatization policy in Tanzania most of government owned schemes were privatized hence this study looked at the Cooperative and Private irrigation scheme.

As of September 2010 Tanzania had 225 600 ha (91.8%) owned by smallholder schemes; 17 440 ha (7.1%) owned by investors in the private sector; and religious institutions, 2703 ha (1.1%) owned by Government institutions (used for growing animals feed) (ASDP, 2010). Today the irrigation sector is completely privatized following the privatization of NAFCO, except for government operations in the support services like research, input supply and extension services (RLDC, 2009).

1.3 Problem Statement and Justification

A recent review of institutional changes of the global water sector has dealt with water law, water policy and water administration as the three pillars of institutional analysis in national water economies (Saleth and Dinar, 2000). Lack of communication can trigger conflicts over resources may be the result into malfunction of institutional arrangement. Studies of institutional arrangements for water resource management have found that the largest hindrance for effective resource management is fragmentation of resource management institutions (Saleth and Dinar, 2004). Williamson (2002) has indicated that without the appropriate institutional arrangements, it is difficult to effectively use economic instruments such as water prices, taxes, or markets to improve the financial sustainability of irrigation projects.

From the above facts it is seen that performance of irrigation scheme cannot be achieved only by funding, good planning, design and construction of irrigation canals to facilitate

the capturing of water from its source and transportation up to the farm level but also with integration of proper institution arrangements (Williamson, 2002). Proper institutional framework specifies the location of investment planning and implementation responsibilities; designates the managing entity, or set of entities, for irrigation system operations; defines regulatory authorities; specifies revenue assessment and collection procedures; establishes dispute resolution processes; and assigns responsibility for allocating and protecting water rights.

Tanzania irrigation projects face declining irrigated acreage as water logging and salinity problems force land out of production (URT, 2007). The existing institutions responsible for irrigation development in Tanzania are characterized by inadequate establishments and weak data base; low skills and awareness of the roles and responsibilities of the stakeholders; inadequate financing; weak enforcement of bylaws; inadequate equipment, facilities and number of qualified staff and absence of irrigation legal framework (MoWI, 2009). This resulted in limited development of irrigation that also limits crop yields. The contribution of irrigated crop production to overall crop production remains quite small, but the potential for expansion is high (URT, 2011). Williamson (2002) found that “success or failure of resource management is intrinsically tied up with the institutional structures the pattern of agencies, laws and policies which pertain to resource issues”.

Hence it has been found that it is important to carry out this study on the role of institutional arrangements on performance of irrigation scheme. It has be seen from previous information that there has been an underutilisation of irrigation potential; this study was designed to contribute to solution for problem that emanated in the existing utilized potential where the irrigation schemes have been working below their capacity. The outcome of this research will contribute to better understanding of the institutional

functioning of irrigation schemes in Tanzania, which could contribute to improvements in their performance. This study will also add to the body of knowledge on institutional arrangement in irrigation schemes in Tanzania of which a little has been written compared to similar studies done elsewhere in the world.

1.4 Study Objectives

1.4.1 Overall objective

The overall objective of this study was to evaluate the role of institutions arrangement on the performance of irrigation scheme. The outcome is expected to contribute on institution improvements hence better performance of the irrigation schemes.

1.4.2 Specific objectives

- i. To assess the institutional and organisational arrangements for private and cooperative irrigation schemes,
- ii. To compare returns on investments for paddy production in cooperative and private institutional arrangements, and
- iii. To evaluate the performance of irrigation scheme with different institutional arrangements.

1.4.3 Research hypotheses

The research hypotheses underlying this study are:

- i. There is no difference in performance of irrigation schemes under each institutional arrangement.
- ii. There is no difference in returns to investments of irrigation scheme under each institutional arrangement.

1.5 Organisation of Dissertation

This dissertation is organised into five chapters; Chapter 1 introduces the Tanzania irrigation sector and institutions involved, defines problem statement, objectives and specifies the research questions. Chapter 2 reviews literatures related to irrigation performance and institution arrangement in Tanzania and other parts of the world. Chapter 3 explains the methodologies used for data collection, and data analysis. Chapter 4 presents results and discussion of the study and is the central part of the dissertation. Chapter 5 presents conclusions and recommendations of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Irrigation Overview

Globally, irrigated agriculture contributes about 40 % of the global food production. This comes mainly from about 260 million hectares of irrigated lands, of which about two thirds are formal irrigation schemes. Many formal irrigation schemes are performing inefficiently for a number of reasons, poor irrigation institutions is one among the reasons for this bad performance (Hector and Martin, 2001).

Tanzania's agriculture is at the mercy of the vagaries of weather. When there are long dry spells, crops fail and socioeconomic dislocation beacons. It has remained unpredictable and of low productivity, this being due to the utter dependence on rainfall which is erratic, unreliable and none uniformly distributed. Irrigation development in Tanzania is critically important in ensuring that the nation attains a reliable and sustainable crop production and productivity as a move towards food security and poverty reduction. The overall irrigation crop production in Tanzania has been greatly affected by low effectiveness of management, operation and maintenance of irrigation schemes (MoWI, 2009).

2.2 Irrigation Institutional Arrangements

Irrigation institution is an entity or organisation that is public, cooperative or private, engaged in irrigation investment and management (in which case it is a hard institution), or policies, laws, bylaws, rules and regulations, procedures, established customs guiding water use, investments, or water allocation mechanisms (a soft institution). Institutional Arrangements: are taken to cover the interrelated set of organisational entities, rules,

incentives and cultural practices that affect or influence irrigation development and practice (MoWI, 2009).

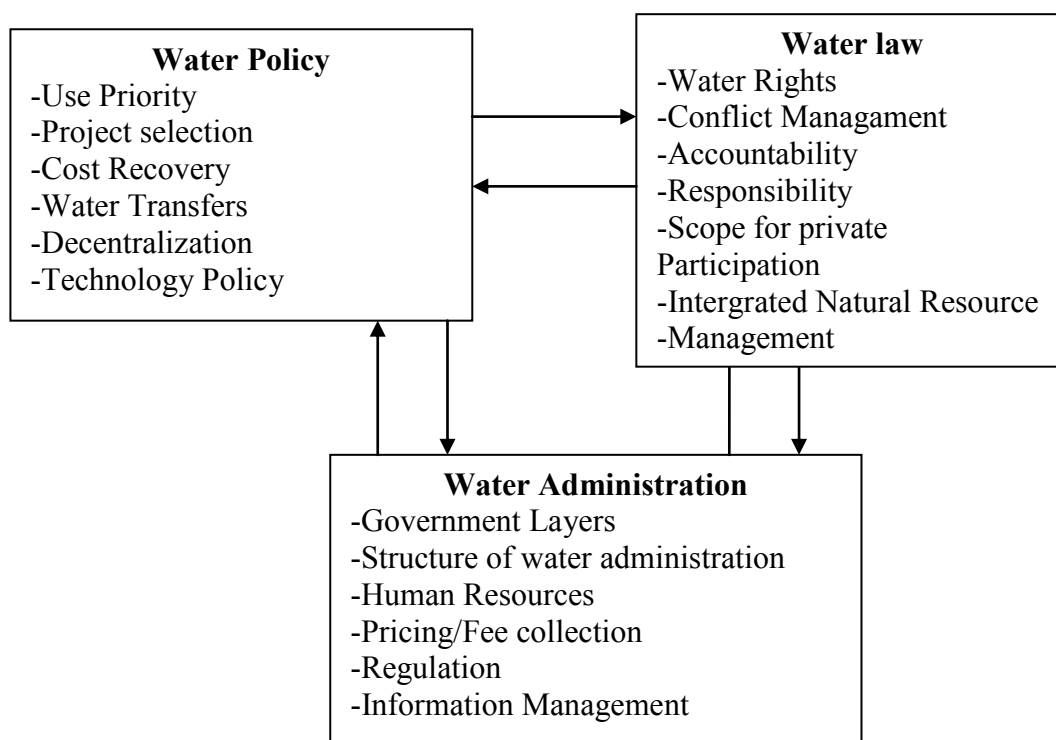


Figure 1: Interlinkages among Water Institutional Components

Source: Adopted from Saleth and Dinar (2004).

Water laws provide the framework for water governance systems and are the pillars for achieving better governance system (Barreira, 2006). Water law refers to many issues including the legal status of water, water rights, conflict resolution mechanisms, and possible contradictions between laws, legal pluralism, administrative regulations, and implementation mechanisms (Saleth and Dinar, 1999).

The water policy defined as vision, it shares the responsibilities at each level (region, state, local governments) for dealing with water or the lack of it. It “covers usage priorities, water tariffs, decentralisation or centralisation of competencies, participation, and coordination with other policies” (Saleth and Dinar, 1999). A national vision/policy

determines how the nation wants to deal with water, address competing goals and objectives (social, environmental, and economic) and establish broad priorities for resource expenditures (Galloway, 2003).

Water administration involves organisations at policy level for resources management and organisations at implementation level for delivery management. Thus formal organisations, organisational procedures, pricing, finance and accountability mechanisms are the preoccupation of water administration.

Also institution refers to social arrangements that shape and regulate human behaviour and have some degree of permanency and purpose transcending individual human lives and intentions (North, 1990). The rules are interpreted and acted on differently by different people. Institutions, including rules, are dynamic and emerge, evolve, and disappear over time.

Examples are water user associations, government irrigation agencies, privatized water companies, water resources research organizations, farmer unions, consultancy firms, nongovernmental organizations, and regulatory bodies. There is enormous diversity in the form, scope, size, structure, permanency, and purpose of organisations. Bureaucracies are a particular type of organization characterized by role differentiation, hierarchical relationships, and formal, written, rules of procedure and accountability. This makes them very different from less formal local associations, but both are organizations. Institutional arrangements which provide positive incentives to use water more effectively are likely to be in the successful uptake and implementation of best water management practices which this will lead to higher productivity, increased and sustained profits, and a healthy environment (Lecler, 2004).

2.3 Tanzania Irrigation Institutions

The existing institutions responsible for irrigation development in Tanzania are characterized by inadequate establishments; inadequate and weak data base; low skills and awareness of the roles and responsibilities of the stakeholders; inadequate financing; weak enforcement of bylaws; inadequate equipment, facilities and number of qualified staff and absence of irrigation legal framework. Linkages between relevant institutions are weak and their respective roles and responsibilities are not clearly defined to the detriment of effective irrigation development. As shown by FAO (2005) and Tanzania national irrigation plan of 2009, the main institutions involved in agricultural water management are:

2.3.1 National level

The mandate to oversee the development of irrigated agriculture is vested the following bodies at National level;

- i. The Irrigation Section (IS) within the Ministry of Water and Irrigation (MoWI) which is responsible for irrigation development;
- ii. The Water Division within the Ministry of Ministry of Water and Irrigation (MoWI) which is responsible for the design, construction, equipment, maintenance and operation of laboratories, water planning, water supply, water research, sewerage and sanitation;
- iii. The Central Water Board (CWB) within the MoWI which is the principal advisory body to the government on matters pertaining to the utilization of water nationally and to the allocation of water rights. It is given executive power over pollution control;

- iv. The National Environmental Management Council (NEMC) within the Ministry of Tourism, Natural Resources and Environment (MTNRE) which is the advisory body to the Government on environmental matters;

This is as found in (FAO, 2005; MoWI, 2009).

2.3.2 Zonal level

The Government has established some technical capacity at the Zonal Irrigation Units (ZIUs) which is an opportunity for the Local level through the ZIUs. The Zonal Irrigation Units will undertake awareness raising, advisory services to Regional and Local Government Authorities (LGAs), Irrigators Organisations (IOs) and the private sector on all aspects of irrigation development, capacity building of IOs and LGAs. They will also provide technical backstopping on studies and detailed designs of irrigation infrastructure, preparation and processing of tender documents for irrigation schemes, construction and supervision of irrigation infrastructure, service provision to the users of irrigation investments and advisory services to private sector in irrigated agriculture (MAFS, 2004). The ZIUs will in collaboration with the Basin Water Offices (BWOs) promote Integrated Water Resources Management in the basins. The former will also strengthen linkage and coordination with Agricultural Training Centers, Research Institutions, extension/advisory services and linkages with the private sector (FAO, 2005; MoWI, 2009). Most of ZIUs are characterized by inadequate financing that made most of activities of the unit being stagnant especially when there is no donor fund; hence the government is advised to put a sustainable means of supporting these units. It is also characterised by inadequate data base, skills gaps, weak enforcement of bylaws, inadequate equipment and facilities to undertake irrigation development (MAFS, 2009).

2.3.3 Local Government Authorities

The Regional Secretariat which is a local agency of central government with the function to encourage local governments to execute and implement policies. Their staffs have been significantly reduced, and part of the personnel transferred to local governments because of the Local Government Reform Programmed (LGRP), which is a major decentralization effort. In the Regional Secretariat, the agricultural officer is responsible for irrigation development (MAFS, 2004).

Local Government Authorities (LGA) which are given greater autonomy. Some executive functions are transferred to them from central government, under the above mentioned LGRP. These reforms will be critical to the delivery of support services to smallholders and rural infrastructure development. In the District Council, the District Agriculture and Livestock Development Officer (DALDO) are in charge of irrigation development. However, not all DALD Offices have irrigation officers and many are seriously understaffed (FAO, 2005; MoWI, 2009).

The main roles of the district in the irrigation development are the implementation of irrigation interventions. These include identification of irrigation schemes; planning and designing; construction; and operation and maintenance of irrigation schemes. However, the districts are characterised by inadequate qualified irrigation professional staff, inadequate data base, skills gaps, lack of awareness of the roles and responsibilities of the stakeholders, inadequate financing, weak enforcement of bylaws, inadequate equipment and facilities to undertake irrigation development (FAO, 2005; MoWI,2009). Furthermore the position of the District Subject Matter Specialist for irrigation is too far below the district organisation structure as he/she reports to the District Extension Officer who in

turn reports to the District Agricultural and Livestock Development Officer who is under the District Executive Director (FAO, 2005; MoWI, 2009).

2.3.4 Irrigators organisations

Irrigators Organisations (IOs) are the lowest appropriate level of management of irrigation schemes. The main functions of these organisations include management, distribution and conservation of water for irrigating their schemes; acquisition of the Water Use Permit from the respective Basin Water Offices; resolution of conflicts among members of the organisations related to the joint use of a water resource and collection of water charges for operation and maintenance and payment of water user fees to the Basin Water Offices. The Irrigators Organisations have other responsibilities which include planning of interventions on their schemes; the implementation of agreed and supported interventions, management and control of resource allocations for implementation of their planned investments and procurement of essential services for irrigation development (FAO, 2005; MoWI, 2009). The main challenges that require to be addressed in IOs are poor linkages with relevant institutions, lack of qualified irrigation professional staff, skills gaps, inadequate financing, inadequate equipment and facilities to undertake irrigation development (MAFS, 2004). Some of leader has also shown low commitment in collecting various contributions from members and using them in the intended goals, this is mainly contributed by weak enforcement of bylaws and cooperative law which governs most of these IOs.

2.3.5 Private sector

The participation of Private Sector in construction, consultancy services, support services and management in irrigation development in Tanzania is very low. Despite the desirability of involving them the capacity to provide such services to the irrigation sector

is limited. On the other hand, the private sector has been investing in large scale commercial farming due to high initial capital investment requirement for irrigation infrastructure, doubt on the security to the right on land ownership and reliable water use permit. The challenges with respect to this sector include attraction and engagement of the private sector as investors (in both service delivery and large scale commercial irrigated farming), and the nature of partnership arrangements for Public Private Partnership (PPPs) in irrigation development (FAO, 2005; MoWI, 2009).

2.3.6 Farmers/Irrigators

In irrigation schemes irrigators identify problems and opportunities associated with their schemes. They participate in the implementation of scheme interventions and are responsible for operation and maintenance of their schemes. However, most of them have limited knowledge of operation and maintenance of irrigation schemes; low awareness on the need to pay water user fees and the willingness to pay these fees is low. Most irrigation schemes have no clear ownership demarcation of the land parcel under irrigation which deprives farmers the opportunity to use it as collateral in financial institution for obtaining required finances for their operations. The ownership of irrigation schemes which are operated communally have to be under the custodian of the irrigators organisation which will take the responsibility of guaranteeing irrigators to financial institutions for obtaining required credits for their operations and development. The private sector has an important role to contribute in the development of the irrigation sector; in this regard they are more relevant in investing in medium and large scale commercial irrigated agriculture (FAO, 2005; MAFS, 2009).

2.3.7 Non-Governmental Organisations (NGOs)

A number of NGOs are already active in Tanzania irrigation sector. The operations of the majority of these NGOs are financed by a range of sources including the Government and its Development Partners. However, in spite of this and the wide range of services that NGOs could potentially provide to the sector, particularly to smallholder farmers, there are still not many NGOs that have the necessary capacity or technical competence in irrigation interventions. Moreover, the existence of most of the NGOs and the range of their areas of operation are not well known by the beneficiaries. They play an important role in irrigation development particularly in the provision of knowledge, information, capacity building and mobilisation of resources at the grass-root level. They will provide independent forums for establishing dialogue between irrigators and the LGAs (MAFS, 2004).

2.4 Tanzania Policies and Legislation

The regulatory and institutional framework for water resources management is provided for under the Water Utilization (Control and Regulation) Act. No.42 of 1974 as amended by the Water Laws (Control and Regulation) Act of 1997 and the Water resource management act of 2009. They stipulate that all water in mainland Tanzania is vested in the United Republic of Tanzania and the Minister responsible for water development is empowered to regulate the use of water from any source in any area of the country on a national basis, to declare such a source to be a national water supply for the purpose of the Act. The Law sets conditions on the use of water and appoints the Principal Water Officer, under the direction of the CWB, to be responsible for setting policy and allocation of water rights at the national level. The Water Act is currently under review. The new Act is expected to establish a mechanism for a more participatory management of water resources (MAFS, 2009).

Tanzania's National Irrigation Master Plan (2002) was prepared including the objectives of "Removal of Sectoral Constraints" and "Implementation of Irrigation Infrastructure". Progress so far has only been about 30 % of the components related to both the objectives mentioned above, while completion is envisaged by 2014. The main reasons for the slow progress are inadequate institutional reforms and lack of human and financial resources. Existing land tenure arrangements do not attract long-term commitments of resources for improving the productivity of land through irrigation or drainage. The 1999 Land Act has laid the foundation for a more transparent execution of land-based transactions and property rights. However, problems in the administrative procedures and in the use of land as collateral for obtaining credit still need to be addressed (MAFS, 2004).

The Agricultural Sector Development Strategy (ASDS), formulation (from 2002-2005) and initial implementation (2006-2007) focuses on applying the principles of integrated soil and water management, emphasizing the use of low-cost approaches by smallholders and to promote and support small-scale irrigation. In July 2002, the Government issued the National Water Policy whose main goals are to establish a comprehensive framework for sustainable development and management of water resources and for participatory agreements on the allocation of water use. The Government will not be in charge of executive functions, i.e. the actual delivery of the services, which are the responsibility of the LGAs. Central statements of the Policy are that "water will be subject to social, economic and environmental criteria" and that "every water use permit shall be issued for a specific duration". This could mean that irrigation might have to compete with industrial sectors and that a continuous irrigation water supply might not be guaranteed. Despite of various policies and legislation initiatives under irrigation sector in Tanzania, there are some challenges that need to be addressed in this area, these include low awareness of the roles and responsibilities of the stakeholders on the policies and legislative issue in

place, weak enforcement of bylaws as well as absence of a clear irrigation legal framework. The linkages between relevant institutions are weak and their respective roles and responsibilities are not clearly defined to the detriment of effective irrigation development (FAO, 2005; MoWI, 2009).

2.5 Relationship between Central Government, Regional and Local Governments, and Social Actors in Water Governance

Figure 2 is a conceptual diagram illustrating the linkages and interfaces between the Central government, regional and local governments, and social actors to bring about an improved governance system. This is similar to a “Triologue” model of governance proposed by Ashton *et al.* (2006). In this model the linkages and interfaces between central government, and the public and their collective partnerships and contributions to “good governance” are shown. “Government” comprises those individuals and institutions that society has selected to provide leadership and direction on its behalf. The social actors comprise individuals, groups and organisations that perform specific actions on behalf of society. The groups are inter-dependent and their interactions are based on agreed sets of principles and values. These interactions support shared understanding, decision-making, and collective responsibility for water resource management. From the functionality perspective governance is seen as comprising the core elements of water policy, water laws, water-pricing mechanisms, international and intra-national (cross-jurisdiction, cross-boundary) agreements (Bandaragoda, 2000).

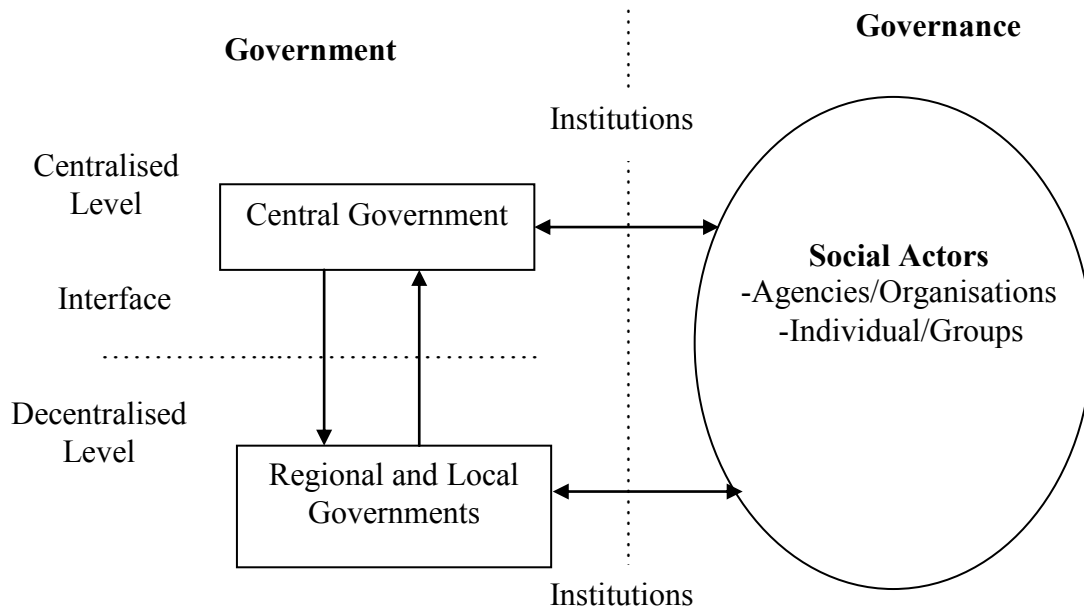


Figure 2: Conceptual diagram illustrating the linkages among the central government, regional and local governments, and Social actors in water governance.

Source: Adopted from Ashton *et al.* (2006).

2.6 Institutional Limitations

Functions of institutions are likely to be affected by climate change, including allocating water resources; implementing and managing water infrastructure; defining and implementing flood management policies; and protecting, monitoring and assessing the quality and quantity of water resources. In particular, there are several key climate change-related challenges that will affect these functions and to which these institutions must respond (Jonathan *et al.*, 2010).

The existing institutions responsible for irrigation development in Tanzania are characterized by inadequate establishments and weak data base; low skills and awareness of the roles and responsibilities of the stakeholders; inadequate financing; weak

enforcement of bylaws; inadequate equipment, facilities and number of qualified staff and absence of irrigation legal framework. Linkages between relevant institutions are weak and their respective roles and responsibilities are not clearly defined to the detriment of effective irrigation development (MoWI, 2009). Hence on rescue of this situation the government under the ministry incharge of irrigation is advised to define clearly irrigation legal framework, create awareness on policies and legislative issues under irrigation as well as facilitation of linkages between relevant institutions for the welfare of irrigation sector.

2.7 Performance of Irrigation Scheme

Performance can simply be defined as “the level of achievement of desired objectives” (Tilahun *et al.*, 2011). Indicators are used to measure performance (See table 1 below for indicators details and examples). Irrigation performance, whether bad or good, is the result of verities of activities such as planning, design, construction, operation of facilities, maintenance and proper application of irrigation water and agronomic activities (Tilahun *et al.*, 2011).

In Tanzania most of the irrigation schemes that received improvement support, their performance gradually deteriorated due to inappropriate system design, ineffective management, low irrigation efficiencies and poor operations and maintenance, which resulted into their abandonment (MoWI, 2009). The linkage between institutions and performance is indisputable. Institutions being rules and role structures, practices and norms, do not perform, or affect any performance on the basis of the strength and validity of institutions, as it is the management or the people in an organisation that actually affect performance. Hence institutions determine the transaction and transformation (production) costs hence improve performance (North, 1990).

From institutional economics viewpoint, basically, institutions affect the performance of an individual, group or organization, a country or its economy, through the effect of institutions on the costs of exchange and production. Together with technology, the institutions determine the transaction and transformation (production) costs (North, 1990). Therefore, in a comparative evaluation of two different sets of institutions, performance can be expected to be better in the institutional framework in which these transaction costs are less. Human actions are constrained and protected by a nested system of different layers of institutions. How management performance is circumscribed by this nested set of institutions is illustrated in Fig. 3.

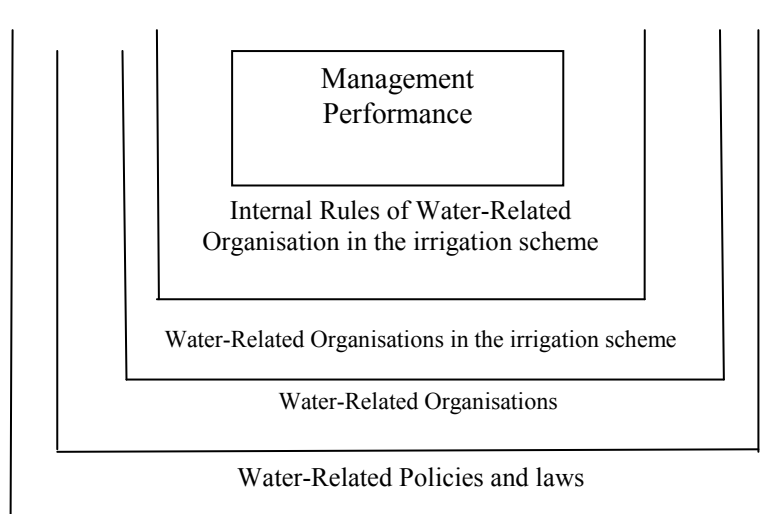


Figure 3: Nested institutions and management performance

Source: Adopted from Bandaragoda, 2000).

The performance of an irrigation system affects the benefits received by farmers. Poorly performing scheme gives lower output to irrigators. Hence lower capacity to manage their irrigation system so that the level of performance of the system declines. This creates a vicious circle of low performance and poverty (Intizar, 2004). Generally, institutions give the structure for exchange that (together with the technology employed) determines the

cost of transacting and the cost of transformation. How well institutions solve the problems of coordination and production is determined by the motivation of the players (their utility function), the complexity of the environment and the measurement and enforcement (Rahel, 2008).

2.7.1 Performance of Management, Operation and Maintenance (MOM) for different institutional arrangements of scheme management

Performance of management, operation, and maintenance of irrigation schemes in different institutional arrangements are determined by various indicators using Weight Average Marks (WAM) as detailed by several authors see Table 1, Table 2, and Table 3. This study has adopted WAM method for performance evaluation as it combined the three criteria of MOM.

Table 1: MOM physical performance indicators, formulation, and data specifications

s/n	MOM performance indicators	Formulation	Data specifications
1	Percentage of actual irrigated area, F, (%):	$F = A / A_p$	Where A is the actual irrigated area in ha in the same year; A_p is the planned irrigated area in ha in the same year (Zhi, 1991 cited by Akar and Ozdmer, 2007).
2	Efficiency of irrigation water supply, s (%)	$S = (w/w_r) * 100$	Where W and W_r are the actual and required annual quantity of irrigation water diverted from the water resources in the same year ($m^3/year$) (Zhi, 1991 cited by Akar and Ozdmer, 2007).
3	Sustainability of irrigated area, F_s , (%)	$F_s = (F_c / F_i) * 100$	Where F_c is the current irrigable area in ha; F_i is the initial irrigable area in ha (Bos and <i>et al.</i> , 1994 cited by Akar and Ozdmer, 2007).
4	Distribution network density, DND, (%)	$DND = (TLD / CD) * 100$	Where TLD is the total length of distributor canals in irrigation scheme; TCD is the total length of conveyance and distributor canals in same irrigation scheme (Frazao and Pereira, 1991 cited by Akar and Ozdmer, 2007).
5	Percentage of drainage facilities in good conditions, QDP, (%)	$QDP = (SCD / TCD) * 100$	Where TCD is the total number of structures for drainage scheme in a particular category (main, secondary, tertiary drainage canals); SCD is the number of structures in good conditions (Koc, 1998 cited by Akar and Ozdmer, 2007).
6	Actualize rate of irrigation planning, WSE, (%)	$WSE = (W / W_s) * 100$	W_s is the quantity that the managers intended to supply according to irrigation planning ($m/year$) (Koc, 1998 cited by Akar and Ozdmer, 2007).
7	Percentage of change of water used unit area, FD, (%)	$FD = (FNM / FNH) * 100$	Where FNM is the water used in unit area (ha) ($m^3/year$). FNH is the amount of water used in unit area in the historical ($m/ha/historical\ year$) (Koc, 1998 Cited by Akar and Ozdmer, 2007).
8	Project irrigation efficiency, E_p , (%)	$E_p = (U_c / W_a) * 100$	Where U_c is the crop irrigation water requirement in project area ($m^3/year$) W_a is the total inflow into canal system ($m^3/year$) (Bos and <i>et al.</i> , 1994 cited by Akar and Ozdmer, 2007).

Source: Akar and Ozdmer, (2007)

Table 2: MOM economical performance Indicators, formulation, and data specifications

s/n	Mom performance indicators	Formulation	Data specifications
1	Percentage of the highest yield per unit quantity of irrigation water, P_{yw} , (%)	$Y_w = (Y / W)$ $P_{YM} = (YW/YWh) * 100$	Where Y_w is the yield per unit quantity of irrigation (ton/m ³); Y is the total annual yield (ton/year). Y_{wh} is the historical highest annual yield per unit quantity of irrigation water ton/m ³ (Zhi, 1991 cited by Akar and Ozdmer, 2007).
2	Percentage of the highest total yield, P_y , (%)	$P_y = (Y / Y_h) * 100$	Where Y is the total annual yield (ton/year) of crops in project area (ha); Y_h is the historical highest total annual yield in the whole irrigation district (ton/year) (Zhi, 1991 cited by Akar and Ozdmer, 2007).
3	Efficiency of collection of irrigation water charges, TE , (%)	$TE = (MTU / MTG) * 100$	Where MTG is the irrigation charges due in the whole irrigation district; MTU is the irrigation charges collected (Koc,1998 cited by Akar and Ozdmer, 2007).
4	Total financial viability, TFC , (%)	$TFC = (GIBO / TIBOG) * 100$	Where $TIBOG$ is the total MOM requirements for irrigation schemes and WUA ; $GIBO$ is the actual MOM allocation (Bos and <i>et al.</i> , 1994 cited by Akar and Ozdmer, 2007).
5	Financial self-sufficiency, E_{yy} , (%)	$E_{yy} = (TG / S) * 100$	Where TG is the total MOM revenue actualized in year researched; S is total MOM cost in the year (Koc, 1998 cited by Akar and Ozdmer, 2007).
6	MOM personnel cost, PGO , (%)	$PGO = (PG / S) * 100$	Where PG is the personnel cost in the year researched, (TSH\$/year); S is the total MOM cost, (TSH\$/year) (Koc,1998 cited by Akar and Ozdmer, 2007).
7	MOM secondary revenue rate, IGO , (%)	$IGO = (SDG / TG) * 100$	Where TG is the total MOM revenue actualized in year (TSH\$/year); SDG is the revenue except for irrigation charges (TSH\$/year) (Koc,1998 cited by Akar and Ozdmer, 2007).

Source: Akar and Ozdmer, (2007)

Table 3: MOM institutional performance indicators, formulation, and data specifications

s/n	Mom performance indicators	Formulation	Data specifications
1	Rate of irrigation groups in irrigation scheme, SGHO, (%)	$SGHO = (ASG / Ap) * 100$	Where ASG is the area operated by irrigation groups (ha); Ap is planned irrigation area (ha) (Koc, 1998 cited by Akar and Ozdmer, 2007).
2	Technical knowledge of staff, TPO, (%)	$TPO = (TPG / TPS) *$ 100	Where TPG is the number of staff with knowledge required to fulfil MOM service; TPS is the total number of staff (Bos and <i>et al.</i> , 1994 cited by Akar and Ozdmer, 2007).
3	Percentage of change of MOM personnel number, PDY, (%)	$PDY = (PSB / PSM) *$ 100	Where PSB is the current number of personnel with knowledge required to fulfil MOM services; PSM is the current number of personnel fulfilling MOM services (Koc,1998 cited by Akar and Ozdmer, 2007).

Source: Akar and Ozdmer, (2007)

2.7.2 Production and productivity in irrigated agriculture

Production and productivity in most irrigation schemes are generally below the expectation. For smallholder traditional irrigation schemes crop production is very low with typical maize and rice yields being 0.8 - 1.0 tons per hectare and 1.8 - 2.0 tons per hectare respectively (MoWI, 2009).

Average rice yields of 4.0 - 5.0 tons per hectare are being realised by some smallholder farmers in improved irrigation schemes. Some farmers in well managed improved irrigation schemes have harvested up to 10 tons per hectare. The inefficient method of land preparation and cultivation where the use of hand hoe is dominant contributes to low production and productivity. The challenge is how to raise crop production with restricted resources of land and water, finance, agricultural inputs and support services. Irrigated agriculture is also constrained by other production practices, storage facilities, marketing,

water management, adequate crop protection and adoption of appropriate technologies for irrigation (MoWI, 2009).

2.7.3 Other studies on irrigation performance with respect to institutions arrangements

Tables 4 and 5 below give the summary of other findings on study of performance of irrigation schemes in different parts of the world, for water user association and private schemes respectively.

Table 4: Other studies on irrigation performance for water user association institutional arrangements

Where (place), author and study	What (institutions involved)	Indicators used	Methodology used and limitation	Performance score
Abdel and Inas (2007); Assessment Indicators for Water Users' Associations in Egypt	Water User's Associations (WUAs),	-Their budget control -The extent of their operation and maintenance work -The extent of the farmer's anticipation. -Payment of fees, etc.), -The number of complaints they receive, -The mechanism for resolving conflicts, - The impact of WUAs on the yield, farming activities,	Testing these indicators was done through performance ratio established This methodology is good but is having limited factors as compared MOM methodology adopted from Akar and Ozdmer which was used in this study	Performance Score was fair. Performance range is very good to very bad.
Mukul, (1998); Efficiency Evaluation of Water Users Associations for Assessing Performances of Irrigation Projects A Case Study India	Water User's Associations (WUAs),	Conventional Indicators like - Irrigation ratio, -Irrigation efficiency, - Cost recovery ratio and maintenance costs	Data Envelopment Analysis (DEA) was employed by evolving relevant inputs and outputs. This methodology did not capture management and maintenance factors of which are also important in reflection of institutional performance.	Data envelop scores was 63% for the WUAs were performing at less than efficiency level 70%.
Kumal and Sanjay, (2012); "Evaluation of irrigation efficiencies for water users' associations in a major irrigation project in India	Water User's Associations (WUAs),	-Maintenance expenditure per meter of the canal. -Measures the quality of maintenance. -Cleaning canals by cutting weeds or removing silt - Measures the quality of water delivery service. - Measures the effectiveness of water fee collection.	Data envelopment analysis was done for different sets of input output by input-oriented model through software. This methodology did not capture management and economic factors of which are also important in reflection of institutional performance.	-It was found that the majority of WUAs had efficiency below 70% which was regarded as effective rate.

Table 5: Other studies on irrigation performance for Private irrigation scheme institutional arrangements

Where (place), author and study	What (institutions involved)	Indicators used	Methodology used	Performance score
Wigginton and Raine, (2001); Measuring Irrigation System Performance in the Queensland Dairy Industry. National Centre for Engineering in Agriculture Publication 179729/5. Toowoomba, Australia.	Private irrigations scheme	-Application efficiency -Distribution uniformity; and -Storage efficiency.	Irrigation Indicators and performance ratios were used to evaluate the findings This methodology did not capture management and maintenance factors and of which are also important in reflection of institutional performance.	-So the storage efficiency is 93.33 % indicating that no deep drainage took place and runoff did not take place unless the irrigation application rate exceeded the soil infiltration rate. -Application Irrigation Efficiency is found to be 106.72% -Distribution efficiency is found to be 100 %. Hence all the measures showed that the scheme was efficient
Ernest et al, (2010); Evaluation of the performance of Centre Pivot Sprinkler irrigation system and its effects on crop yield at Kagera, Tanzania. Second RUFORUM Biennial Meeting 20 - 24 September 2010, Entebbe, Uganda	Private company irrigations scheme	-Examined soil parameters that influence cane yield - The quality of irrigation water.	-Data for centre pivot performance were analysed using formulas and Microsoft office excel. Statistical approaches were also used to establish significance. Water samples were also collected for laboratory analysis This methodology did not capture management and maintenance factors of which are also important in reflection of institutional performance.	Centre pivot GP7 had an average coefficient of uniformity of 96.9% as opposed to 86.2% for BPS. -The results showed that low yields were contributed by both poor pivot performance and soil parameters. Centre pivot GP7 had an average coefficient of uniformity (CU) of 96.91% while it was 86.28% for BP5; -Average distribution uniformity (DU) of 95.1% and 78.23%; average potential application efficiency (PELQ) of 86.83% and 79.14%; and -Average application efficiency (AELQ) of 64.97% and 59.36%. The minimum recommended values for CU, DU, PELQ, and AELQ were 85%, 75%, 90%, and 85% respectively. The performance parameters for GP7 were within the recommended minimum values except AELQ which was lower than the minimum recommended value, whereas PELQ and AELQ for BP5 were lower than the Minimum recommended values.

The above studies shows different methodologies used to study irrigation institutional performance for Private and cooperative irrigation schemes institutional arrangements. Each methodology covers some factors while leaving others. This study after learning from various methodologies it has opted MOM methodology adopted Akar and Ozdmer, (2007) as it tried to reduce this effect by grouping the factors in three groups which are Management, Operation and maintenance. This gave option for digesting from each group hence accommodated more factors as compared to other factors.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

This study has taken both private owned and cooperative owned institutional arrangements. The two irrigation schemes are found in Mbarali District in Mbeya–Tanzania. The chosen irrigation schemes are Highland/Mbarali Estate which is privately owned and Igomero smallholders' irrigation scheme owned through cooperative arrangement. The aim of taking these two irrigation schemes was their presence in the same natural environment, so different in performance of the two schemes should be from mainly technical, institutional arrangements and economic differences.

Both schemes studied in this research are found in Usangu plains within the Rufiji river basin in Mbarali District in Mbeya Region. Mbarali District is one of the seven districts and eight councils that form Mbeya region. The District was established on seventh July 2000 by the Local Government Act No. 8 of 1982 as amended by Act No. 6 of 1999 and received certificate of registration on 5th June 2003 (MDC, 2010).

The District geographical coordinates are 8° 35' 0" South, 38° 40' 0" East'. It's altitude ranging from 1000 to 1400 meters above sea level. Average temperatures range between 25⁰C and 30⁰C. The mean annual rainfall is about 650 to 800 mm (MDC, 2010).

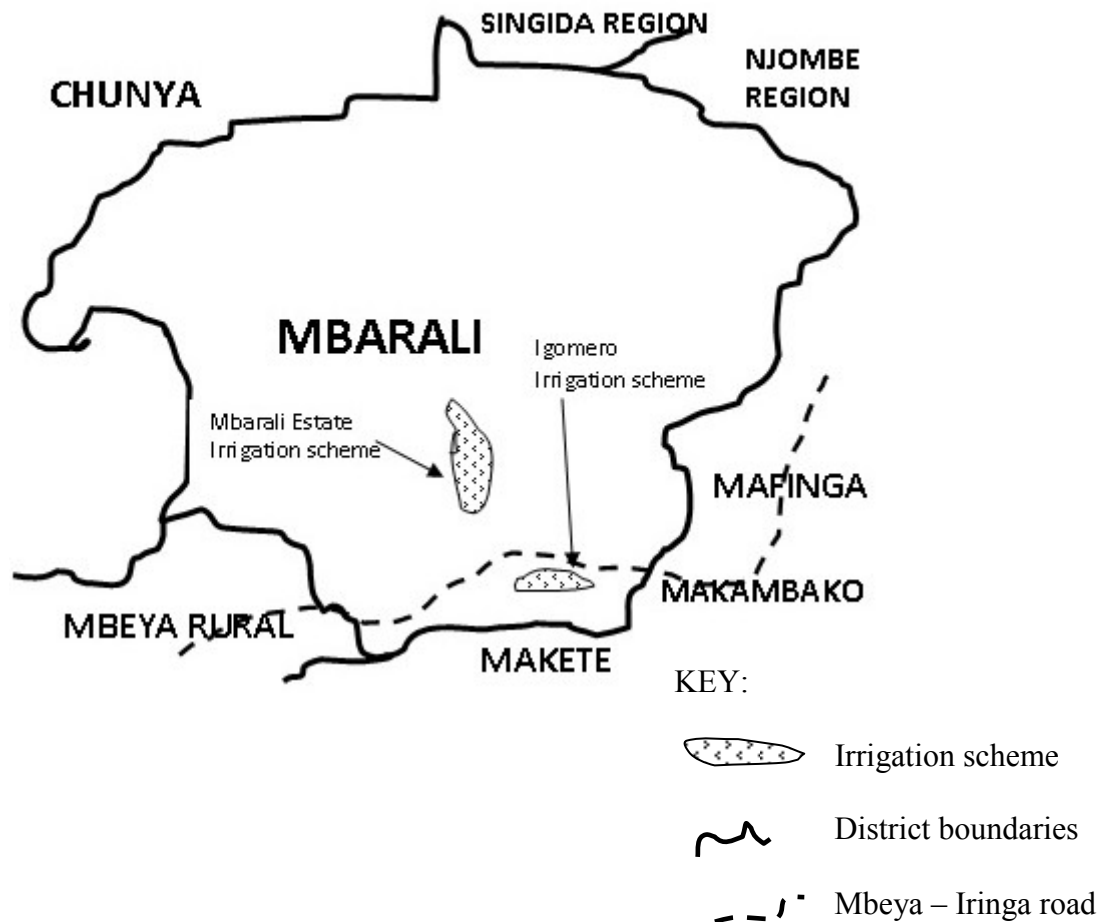


Figure 4: Location of irrigation schemes under this study

Source: MDC, (2010) with minor modifications

Economy of the Mbarali community depends mainly on crop production and livestock keeping. About 83% of the Mbarali community is engaged in agriculture mostly paddy farming, and few in businesses, fishing, livestock and civil services. Per capita income of Mbarali in the year 2008/2009 was Tshs 350,000. Rice and sunflower are the main cash crops that are used for business transaction within and outside the District (MDC, 2010).

Area under irrigation at Mbarali District covers an area of 1 556 000 ha, it is found on Usangu plateau. It has about 48 irrigation schemes with over 71 600 ha of potential irrigated land. Despite of this potential irrigation land only about 17 schemes are developed with the area of 10 141 ha and the rest are traditional (MDC, 2010).

According to Tanzania National Bureau of Statistics (NBS) (2013), Mbarali district had a total population of 300 517 with an average household Size 4.3. The current population projection is about 282 911 whereby 140 385 are males and 142 526 are females (URT, 2013). The major ethnic groups are Sangu, Hehe and Bena. In addition, there are other small tribal groups including Sukuma, Wanji, Barbeig, Masai, Kinga, Nyakyusa and Gogo, most of these tribes are immigrants due to livestock and smallholder farming.

3.2 Data Source and Collection Methods

3.2.1 Data sources and types

This study used a cross-sectional in research design. Under this design, data from population was collected at a single point of time without repetition from the representative population. Both primary and secondary data collection methods were used to obtain sufficient and realistic information and justification to the findings.

3.2.1.1 Primary data

Primary data was collected using various methods included questionnaires, interviews, observation and documentation. A structured and semi-structured interview was administered to irrigators from both cooperative and private irrigation schemes.

3.2.1.2 Secondary data

Secondary Data was obtained from literature sources or data collected by other people for some other purposes. Thus secondary data provide second hand information and include both raw data and published ones (Saunders *et al.*, 2009). The major sources of secondary data were collected from Mbarali District Agriculture and Livestock Development Office, Southern highland Zonal Irrigation Unit and Uyoale Agricultural Research centre; the Mbarali District Irrigation Department and the ward and village offices. Other secondary

data were drawn from research books, journals, publications and other sources relevant to the study and websites was explored.

3.2.2 Methods of data collection

3.2.2.1 Field visits

Farm visits were made for each scheme. The aim was to assess each scheme's, irrigation channel structures/systems used, farm operation constraints management aspects and other information. Farm discussions were held during farm visits and were instrumental in providing the researcher with more insights on farming systems.

3.2.2.2 Key informants

This was done on the last day of the village visit when the researcher walked around the scheme for informal interviews and discussions. The objective was to crosscheck (triangulate) the already collected information.

3.2.2.3 Survey

The survey instrument was administered for data collection in the field to gather information about irrigators from Mbarali estate farm and Igomero irrigation scheme; the questionnaires were administered to the head of the household (refer Appendix one for details). Two enumerators were employed to collect data from households engaged in irrigated farming.

3.3 Sampling Method and Sample Size

The research applied sampling procedure namely simple random sampling. The sampling unit for this study constituted of irrigators (farmers) from both private and cooperative institutional arrangement. A procedure for random sampling of respondents was being

employed using existing lists of farmers from the Igomero Irrigation cooperative society office and Highland/Mbarali estate scheme office. This technique has been recommended in social research by Kothari (2004). The sample size was obtained by using the following formula below.

$$s = \frac{N}{1 + N(e)^2}$$

Where; S = sample size, N = population size and e = level of precision or error, the recommended e for social science research is 5% because it gives the confidence interval of 95%. However, if there is a resource limitation, investigators or researcher may use a larger e (e.g. 10%) (Naing *et al.*, 2006). Therefore this study suggested e = 10% since the population was assumed to be homogeneous. For private irrigation scheme N=1271, e = 0.1 hence on inserting in the formula above we get a sample size of 93 respondents, while for cooperative irrigation scheme N= 462, e =0.1 hence on inserting in the formula above we get a sample size of 82 respondents.

The sample size of 175 individuals was selected at random as respondents from both schemes for the interviews; the adoption of this number of these respondents was based on the sample size formula above. The sample size is reasonably large especially in conformity with Bailey (1994) argued that around 30 cases seems to be the bare minimum for studies in which statistical data analysis can be done using statistical analysis software like SPSS statistical package for social studies(SPSS).

3.4 Conceptual Framework

Generally the framework conceptualizes the outcomes of the decentralisation reforms as the result of how local governance actors organize the institutional arrangements to respond to the post-decentralization opportunities and constraints. Figure 5 shows a

framework adopted from Douglas *et al.* (2006) with minor modifications which have been applied to explore the role of institutional arrangement in performance of irrigation scheme in this study.

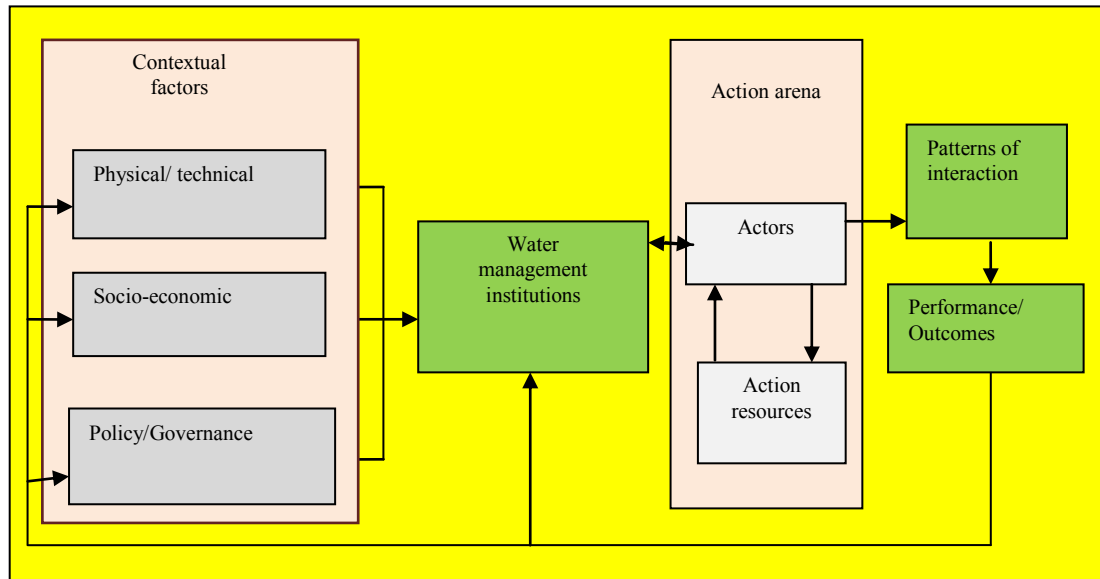


Figure 5: Presents modified institutional analysis and development framework
Source: Adopted from Douglas *et al.* (2006).

Action arena is a first step in an institutional analysis was to establish the boundaries of the analysis to delineate the action arena. To identify the factors that influence the variation in local government success in a country's irrigation sector, the action arena may be defined as the irrigation sector.

Actors are defined by the institutional design of the country's irrigation policy, and may include any combination of private landholders, rural community groups, water-user groups, NGOs, externally funded project representatives, municipal governments, central-government agents, private irrigation firms, and others.

The physical/Technical aspect is one of the most important issue in institutional analysis is to define the nature of the good that is involved in the action situation. At the most fundamental level, the general characteristics of the country's irrigation and water resources frequently resemble a loosely regulated common-pool resource (CPR) and such a characterization helps to define the physical conditions of the action arena's context.

Socioeconomic Conditions are physical conditions set the stage for the community attributes. Under this heading we examine how actors relate within and between clusters of other actors. We consider the historical background, culture, religion, values, beliefs, knowledge, skills, health conditions, poverty level, and other socioeconomic characteristics of the groups defined as the main actors.

Rules-in-use of the water management institutional arrangements: the rules-in-use refer to the norms that are actually respected by the actors participating in an action situation. These are the most important independent variables in an institutional analysis because these rules influence the incentives that each actor faces and thus ultimately help determine behaviour (for more on how rules-in-use relate to incentives, see Gibson *et al.*, 2005).

Patterns of Interactions in the different action situations create patterns of interaction that, over time, result in predictable outcomes. By studying these patterns, one can identify the institutional incentives of the different actors in a given action situation. Because of the framework's design, these incentives can be traced back to specific contextual factors that seem to generate the observed incentives.

3.5 Data Analysis

3.5.1 Study of organisational and institutional factors versus irrigation performance using linear regression

Factors for objective one which aimed at studying types the institutional and organizational arrangements of irrigation water management were collected from the primary and secondary sources was analysed using qualitative methods and descriptive statistics. From the conceptual framework adopted it was found that the independent variable (Y) which implied the institutional performance is contributed by various factors (X variables) like distribution of task in the organisation structure of the organisation, participation of stakeholders in decision making, interaction between the irrigation organisation with other different stakeholders in the sector, presence and relevancy of laws and policies in the sector and their enforcement, effectiveness in monitoring and planning of irrigation infrastructures, effectiveness in collation of various fees from stakeholders, extent of occurrence of various problems/accidents in the irrigation infrastructure as well as efficiency in use of other inputs with irrigation water inclusive in production of crops. The details of these variables are found on Appendix 1.

Linear regression was run to see the relationship between various variables and institutional performance analysis, Chi square and “t” test was used to see if there was any significance difference between the two institutional arrangements. Finally, the outputs of the statistical analysis were discussed using tabulation, means, frequencies, percentages and figures were used in this report to present the key findings of the study.

The linear regression model was used to study the relationship between institutional performance and its variables. The results on overall institutional performance is influenced by various factors as shown in the model

$$Y = B_0 + B_1 X_1 + B_2 X_2 \dots + B_9 X_9 + e \dots\dots\dots(1)$$

Where;

Y= Institutional performance

X₁ = Distribution of task,

X₂ = Stakeholders have participated in decision making,

X₃ = Interactions with other different institutions,

X₄ = Importance of irrigation laws and policies,

X₅ = Activeness in enforcing laws,

X₆ = Presence of effective monitoring and planning system,

X₇ = Effectiveness in the collection of fees and penalties,

X₈ = Extent of occurrence of problems/accidents,

X₉ = Efficiency in the use of inputs for production.

B₀ = Show Y intercept

B₁...B₁₀ are coefficient of various values of X

e = Stands for an error term

3.5.2 Production and returns to investment analysis

Returns to investment model development aimed to look at income obtained resulted from paddy crop subjected to the restrictions of irrigation charge, labour and inputs for production in a cropping area. Paddy yield production function is the mathematical relationship between inputs and outputs.

Paddy Production function;

Dimensions of Paddy production = f (Harvested paddy value, Cropped and irrigated area, Value of different inputs used in production, labour cost used for production of paddy)

The gross income per unit area was determined as being proportional to the production, while the costs were taken from fixed variable and component dependent (Dao, (2000).

The gross income was expressed as shown below:

$$GI = \sum_{i=1}^n P_i X_i Y_i(W) \dots\dots\dots(2)$$

Where,

GI = Gross income obtained by crop, in an X area, in Tsh;

P_i - sale price of the crop product i, in Tsh ha⁻¹;

Y_i (W) = crop production, in kg.ha*1;

X_i = cropped and irrigated area with crop i, in ha; and

i = integer pertaining to the crop (1, 2, ...93).

Considering production cost which was represented:

$$CP = \sum_{i=1}^n (Q_i \times R_{i,tot} + L_{i,tot} \times W) \dots\dots\dots(3)$$

Where;

CP = Cost of production in Tsh;

Q_i = Quantity of different inputs (seed, fertilizer, fuel, labour, insecticides and fungicides) used for crop production in (kg or lt) as well as irrigation cost.

L_i = Total amount of labour used for production of crop i (in man days)

R_i = Price of different inputs used for production of crop i (Tsh kg⁻¹ or lt⁻¹)

W = Local wage rate (same for all households) for selected crop (Tsh man day⁻¹).

Where Net revenue is given by

$$NR = \sum_{i=1}^n (GI - CP) \dots\dots\dots(4)$$

Where;

NR = Net revenue

GI = gross income obtained by crop, in an X area, in Tsh;

CP = Cost of production in Tsh

n=Different households (where n is 1, 2, 3..., 93)

Return on Investment (ROI) is found by taking net revenue divide it to total production cost could hardly be simpler. Just subtract the cost from the gain and divide the difference by the cost. Then multiply by a hundred to convert the ratio into percentage form.

$$ROI (\%) = (Gross \text{ crop revenue} - \text{Production Cost}) / \text{Cost} * 100$$

$$ROI(\%) = \frac{NR}{\sum_{i=1}^n (GI - CP)} \dots\dots\dots(5)$$

This model was used to study objective two of this return on investment on paddy production in the study area. The variable in the model was captured by collecting data from the primary and secondary sources. Analysis of this objective was done using returns on investment model, gross Margin Analysis method by adopting the model by Mengistu, 2008 with minor modifications for comparison of cost and revenue. As well as qualitative data analysis where “t” test was used to see if there was any significance difference between the two institutional arrangements performance.

3.5.3 Irrigation institutional performance model

The irrigation performance model for this study is adapted from Akar and Ozdmer, (2007) with some modification and leaving some of factors which are not relevant to the study area. The Model details are found in Table 6 in this chapter, the model is specified for each of the three dimensions of performance as follows:

$$\text{Irrigation Performance} = \sum_{i=1}^n (ODI_i \times WTI_i) + W \quad \dots\dots\dots(6)$$

Where:

$$\sum_{i=1}^n (ODI_i \times WTI_i) = (\text{Physical factors} + \text{Economic factors} + \text{Institutional factors}) \quad \dots\dots\dots(7)$$

W Presents other factors and it accounts for 10% of the irrigations scheme performance model. It is found by the summation of $\Delta MK1$, $\Delta MK2$, $\Delta MK3$ and $\Delta MK1$

- i. $\Delta MK1$ =Show preparation of office records like, tables and charts of management;
- ii. $\Delta MK2$ =Shows sound management organization and training of management personnel;
- iii. $\Delta MK3$ =Show application of advanced technique has been applied and proved to be effective;
- iv. ΔMK^1 =Is the deduction of marks due to an accident arising from the negligence of management personnel;

$\Delta MK1$, $\Delta MK2$ and $\Delta MK3$ respectively weighs 4%, 4% and 2% respectively of the irrigation performance in the Model.

NB: ΔMK^1 is deduction of marks; it ranges from 1% to 2% for ordinary accidents and 5% to 7.5% for frequency accidents occurrence due to negligence of management personnel.

The discussion Table 2 revealed that, physical factors included in the model, weighs 40% of the irrigations scheme performance. The components making physical factors with their coefficients are as follows:

- i. Percentage of actual irrigated area (0.08);
- ii. Efficiency of irrigation water supply (0.06);
- iii. Sustainability of irrigated area (0.03);
- iv. Distribution network density (0.04);
- v. Percentage of irrigation facilities in good conditions (0.06);
- vi. Actualize rate of irrigation planning (0.03);
- vii. Percentage of change of water used unit area (0.03);
- viii. Project irrigation efficiency (0.07);

Economic factors weigh 40% of the irrigations scheme performance model. The components making economic factors with their coefficients are as follows;

- i. Percentage of highest yield per unit quantity of irrigation water (0.05);
- ii. Percentage of the highest total yield (0.01);
- iii. Efficiency of collection of irrigation water charges (0.07);
- iv. Total financial viability (0.06);
- v. Financial self sufficiency (0.08);
- vi. Management personnel cost (0.02);
- vii. Secondary revenue rate (0.02);

Institution factors included in the above model, weighs 10% of the irrigations scheme performance model. The components making Institution factors with their coefficients are as follows;

- i. Rate of irrigation groups in irrigation scheme (0.02);
- ii. Technical knowledge of staff (0.03);
- iii. Percentage of change of operations personnel numbers (0.05);

This model is applied in evaluation of objective three of this study. The details of the variables under study of this objective are found in Table 2. This table explains Performance of Management, Operation and Maintenance (MOM) for different institutional arrangements of scheme management, the methods for determining the mark and weight of each index were given. The table 6, 7 and 8 gives details of calculation of weighted average marks for various variables.

Table 6: Methods for determining the mark and weight of physical factors

No	Names, symbols and units of MOM performance indicators	Methods of calculating marks (MK=Marks)	Values of weight (WT=Weight)
1	Percentage of actual irrigated area (F), (%)	$MK=2F-100$	0.07
2	Efficiency of irrigation water supply (S), (%)	$S \geq 100; MK=1000,$ $S < 100; MK=S$	0.05
3	Sustainability of irrigated area (FS), (%)	$FS < 100; MK=FS$ $FS \geq 100; MK=100$	0.02
4	Distribution network density (DND), (%)	$MK=DND$	0.02
5	Percentage of irrigation facilities in good conditions (QIP), (%)	$MK=2QIP-100$	0.05
6	Actualize rate of irrigation planning (WSE), (%)	$WSE=100; MK=50+0,5WSE$ $WSE > 100; MK=150-0,5WSE$	0.03
7	Percentage of change of water used unit area (FD), (%)	$FD=100; MK=50+0,5FD$ $FD > 100; MK=150-0,5FD$	0.03
8	Project irrigation efficiency (EP), (%)	$EP \leq 25 MK=50; 26 \leq EP \leq 35$ $MK=70$ $36 \leq EP \leq 45 MK=80; 46 \leq EP \leq 55$ $MK=90; 56 \leq EP \leq 65 MK=100$ (Border and furrow irrigation method)	0.06

Table 7: Methods for determining the mark and weight of economic factors

No	Names, symbols and units of MOM performance indicators	Methods of calculating marks (MK=Marks)	Values of weight (WT=Weight)
1	Percentage of highest yield per unit quantity of irrigation water (Pyw), (%)	$MK = 2Pyw - 100$	0.05
2	Percentage of the highest total yield (PY), (%)	$MK = 2PY - 100$	0.10
3	Efficiency of collection of irrigation water charges (TE), (%)	$MK = TE$	0.07
4	Total financial viability (TFC), (%)	$TFC \geq 100$; $MK = 100$ $TFC < 100$; $MK = FC$	0.06
5	Financial self sufficiency (EYY), (%)	$EYY < 100$; $MK = EYY$	0.08
6	MOM personnel cost (PGO), (%)	$PGO = 35$; $MK = 100$; $35 < PGO = 50$; $MK = 50$; $50 < PGO = 100$; $MK = 25$	0.02

Table 8: Methods for determining the mark and weight of institutional factors

No	Names, symbols and units of MOM performance indicators	Methods of calculating marks (MK=Marks)	Values of weight (WT=Weight)
1	MOM secondary revenue rate (IGO), (%)	$MK = IGO$	0.02
2	Rate of irrigation groups in irrigation scheme (SGHO), (%)	$MK = SGHO$	0.02
3	Technical knowledge of staff (TPO), (%)	$TPO \leq 100$; $MK = 50 + 0.5TPO$ $TPO > 100$; $MK = 150 - 0.5TPO$	0.03
4	Percentage of change of MOM personnel numbers (PDY), (%)	$PDY = 100$; $MK = 50 + 0.5PDY$ $PDY > 100$; $MK = 150 - 0.5PDY$	0.05

Method of calculating the weighted average mark (WAM) index for a given institutional arrangement was calculated by the model in equation three. The details of weighted average mark and its calculation is found in appendix three.

3.5.4 Limitation of the methodology

Despite of the fact that this methodology captured different institutional factors still most of factors were not accommodated. In trying to reducing this effect, the factors were group in three groups which are Management, Operation and maintainance so as to get enough time to digest each group in detail instead on taking them in one category. In addition to that before taking the data collection tool to the working area it was tested at Igurusi irrigation scheme to see its relevance and accommodate the feedback to improve the tool. There was also a deep discussion with key personnel in the field to see which factor may have been left over; all these activities were done to reduce the limitation of this working tool.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Characteristics of the Population, Organisation and Institutional

4.1.1 Social economic characteristics of study population

Table 9 shows the distributions of respondents by different social economic characteristics like age, education, marital status and training in agriculture and irrigation. It indicates that the majority of respondent from both private and cooperative irrigation schemes were males, making 80% and 81.2% respectively of all respondents. The questionnaires were administered to the head of the household, many households being headed by male hence this lead in the observed dominance of males in number of respondents. Most of the respondents were married as it was shown that 83.8% and 82.5% of respondents from private and cooperative irrigation scheme respectively were married. This indicates that in both irrigation schemes the population were stable in their economic activities.

Table 9: Social economic characteristics

Institutional arrangement		Private company	Water users cooperative
Sex	Male	80.00	81.20
	Female	20.00	18.20
Marital status	Single	8.80	8.80
	Married	83.80	82.50
	Divorced	6.20	6.20
	Widow	1.20	2.50
Education level	Informal education	23.80	23.80
	Primary	53.80	48.80
	Secondary	10.00	18.80
	Certificate/high school	1.20	5.00
	Diploma/higher education	6.20	2.50
Age group	30< Years	16.25	21.25
	30<Years>45	46.25	41.25
	Years<45	37.50	37.50
Training	Farmers trained	93.80	33.80
	Farmers not trained	6.20	66.20

Most of the respondents were standard seven leavers, where few of them were having education above secondary school. Irrigators in both irrigation schemes were mainly aged between 30 years and 44 years with 46.25% and 41.25% of the respondent from private and co-operative schemes respectively. It was found that most of youths under 30 years are not engaged in irrigation as this group took only 16.25% and 21.25% of private and cooperative scheme respondents. They were found to engage in other sub sectors like “*bodaboda*” (motorcycle drivers), petty business, carpentry, mason or work as labours in the farming business. This could be due to cost of acquiring irrigation land being high for most of the young, this leads to low participation in irrigation activities. All the difference of the above factors was found to be not statistically significance except the difference in receiving training on agriculture and irrigation. Many farmers, about 93.8% from the cooperative irrigation scheme were trained as compared to 33.8% of private farmers from irrigation who were trained. This difference was statistically significant hence it is expected that irrigators from cooperative scheme to adhere to the best agricultural practice and maintenance of scheme infrastructure more as compared to irrigators from private irrigation scheme most of whom did not get such training.

4.1.2 Institutional and organizational arrangements of irrigation water management

The organisational structure of the two schemes reveals that, Cooperative scheme adopted the “Bottom-up” approach administration. The irrigators are the ones who decide what is to be done by the management and they are the one who put the management in or out of power, however in its operation there is exchange of ideas mechanism with getting feedback. Figure 6 and 7 addresses objective 1.4.2(i) explain the structure of cooperative and private irrigation scheme respectively.

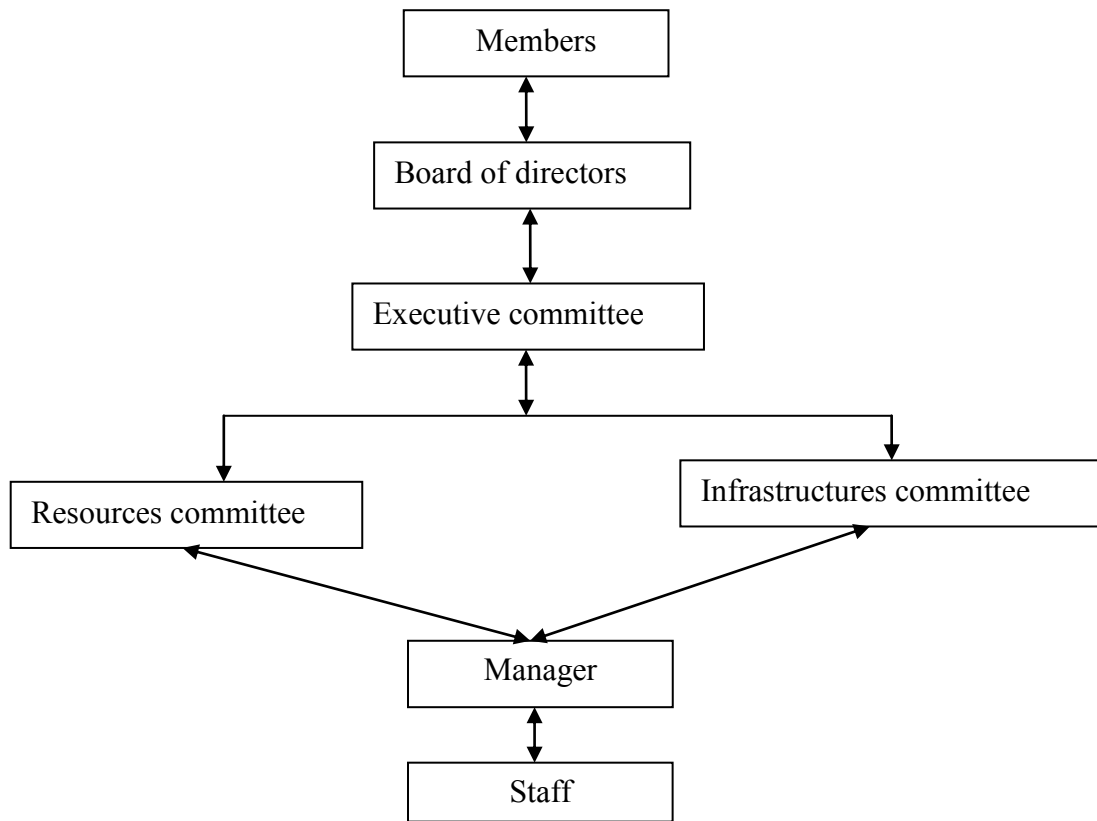


Figure 6: Igomero irrigation scheme organizational structure distribution of tasks structure (Bottom- up)

Private irrigation scheme follows the “Top Down” method of administration, where decision comes from top management of the scheme to lower levels management and finally to the clients level. In private irrigation scheme irrigators should accept terms and condition stipulated by the management of the irrigation scheme so as to enjoy irrigation water service, the estate manager is incharge of maintenance and operation of the irrigation infrastructures. The irrigators hire the irrigation plots from the investor and pay a fee for that. Figure 7 shows the relationship and distribution of power among the stakeholders. Irrigators are considered as the third party, hence not included in the structure.

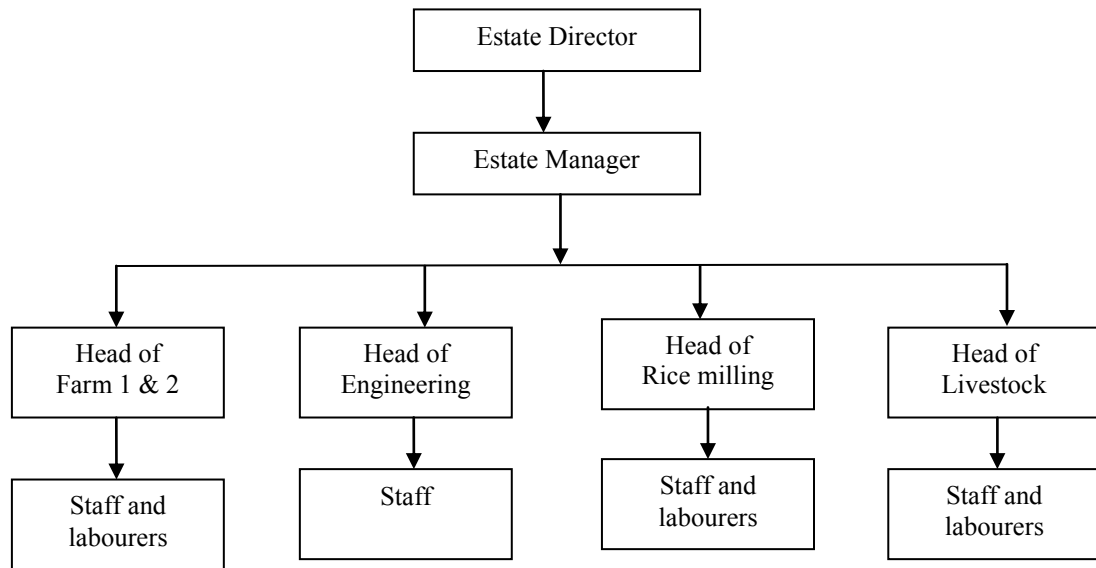


Figure 7: Mbarali Estate organisational structure and distribution of tasks structure (Top-Down)

4.1.3 Cooperative and private scheme institutional performance

The findings indicate that the institutional performance in cooperative and private irrigation schemes was influenced by various factors in different rate as seen in the Table 11. The factors that showed significance in contribution of institutional performance are extent of occurrence of problem, interconnection of different institutions, distribution of task effect, activeness in enforcing laws, presence of effective monitoring and planning system and perception toward importance of irrigation laws and policies. The model for both schemes was found to be significant, with significance value of 0.001 and 0.000 levels for cooperative and private irrigation scheme respectively. Some factors like extent of occurrence of problems, distribution of task and training were found to be significant in both schemes, these can possibly indicate that these factors are more influential to the institutional performance as compared to others. The variable in the model showed the value of R square is 0.484 and 0.501 for cooperative and private irrigation scheme respectively (Table 10 shows details of this). This implies that the dependent variables have managed to explain independent variables by 48.4% and 50.1% for cooperative and

private scheme respectively. This finding indicates that about 50% of irrigation scheme performance is influenced by institutional factors, the remaining 50% is influence other factors apart from institutional factors which are like the breed of seeds used, type and quantity of various inputs used, technology used and weather during the growing season and others, error term catches these other factors.

Table 10: Anova table showing significance level of the model and power of independent variables in expressing the depending variable

	Cooperatives scheme			Private scheme		
	Regression	Residual	Total	Regression	Residual	Total
Df	12.000	66	78	18.000	60	78
F	3.946			3.342		
Sig.	0.000*			0.000*		
R	0.646*			0.708*		
R Square	0.418			0.501		
Std. Error of the Estimate	0.460			0.729		

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Table 11 presents results on regression model used to study the relationship between institutional performance and its variables like distribution of task, stakeholders participation in decision making, interactions with other different institutions, importance of irrigation laws and policies, activeness in enforcing laws, presence of effective monitoring and planning system, effectiveness in the collection of fees and penalties, and extent of occurrence of problems. From the results in the table, the variables which were found to have significant contribution on institutional performance were extent of occurrence of problems/accidents in the process of operations and maintenance of the irrigation scheme, the influence is found to be -27.5% and -19.3% for cooperative and private scheme respectively. This implies that the occurrence of problems reduces the

institutional performance by the respective percentages hence the management of both scheme are to work hard to minimize the occurrence of problems in the scheme.

Table 11: Showing coefficient of various variables used in determining institutional performance and their significance

Model	Cooperative scheme			Private scheme		
	Standardized Coefficients	t	Sig.	Standardized Coefficients	t	Sig.
(Constant)		0.906	0.369		0.645	0.024
Extent of occurrence of problem	-0.275*	2.448	0.017	-.0.193*	-1.812	0.075
Interconnection with different institutions	0.192*	-1.740	0.087	0.108	1.055	0.295
Distribution of task effect	0.375***	3.770	0.000	0.332***	2.440	0.004
Activeness in enforcing laws	0.265**	2.369	0.021	0.051	0.420	0.676
Effectiveness in collection of fees and penalties	-0.036	-0.309	0.759	-0.111	-1.087	0.282
Efficient use of inputs	0.244	0.824	0.413	0.088	0.415	0.680
Presence of effective monitoring and planning system	0.276**	2.219	0.030	0.085	0.742	0.461
If the stakeholder have participated in decision making	0.165	1.380	0.173	-0.092	-0.859	0.394
Perception toward organisation structure	-0.124	-1.065	0.291	0.097	0.812	0.420
Perception toward importance of irrigation laws and policies	-0.001	-0.013	0.990	0.055	0.525	0.601
Whether member receive training	0.278**	2.315	0.024	0.347***	3.086	0.003

a. Dependent Variable: performance of current management

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level

Other factor that was also observed is the distribution of task, this influences the performance of cooperative and private scheme by 37.5% and 33.2% respectively. This result indicates that more than 30% of the performance is influenced by the nature and effectiveness in distribution of tasks, hence both management are to enforce the effectiveness in distribution of task as well as ensuring each respective part in their organisation structure in accomplishing task given timely and effectively. This must go hand in hand with training of staff, management and stakeholders in maintenance of the scheme as well as agriculture best practice as it is found to influence the performance by 27.8% and 34.7% for cooperative and private scheme respectively. This finding indicates that the scheme administration should do training as well as employing extension officer for facilitation of enforcement of adhering to agriculture best practices and scheme infrastructure maintenance.

Other factors that influenced the performance of scheme which were found to have significant value are inactiveness in enforcement of laws and effectiveness in monitoring and planning in scheme management which affect the performance of cooperative and private schemes by 26.5% and 27.6% respectively. This notifies the scheme management in enforcement of the laws and regulation of the scheme as they have positive contribution on performance of the scheme as well as having in place best plans and effective monitoring system of the irrigation scheme facilities in place. Effectiveness in planning and maintenance of the irrigation scheme helps to reduce a number of problems/accidents in the irrigation scheme hence best performance.

Based on the above findings, it has been found that the two institutional and organisational arrangements differ, regression model for each institutional performance shown different respond on the variables tested on each of them. These differences are in

management style where one used down-top and the other top-down management styles as well as difference in the nature of by-laws governing these schemes. The institutional variables compared showed a statistically significance difference among the institutions studied as seen in table 10. Hence from these findings hypothesis one, saying that “the two institutional and organisational arrangements behave the same” is rejected.

4.2 Paddy Production Returns on Investment in Different Irrigation Schemes

Table 12 shows that net average incomes were 1 030 175.00 and 1 421 918.78 Tsh. for private and cooperative irrigation schemes respectively. The difference in net income between these two irrigation schemes was statistically significant at 0.000 level of significance.

Table 12: Average cost and revenue of paddy per acre

	Irrigation scheme type		Significance level at 95% confidence interval
	Cooperative	Private	
Average productivity of paddy per acre (Kg)	2 403.38	2 455.75	0.01
Average Price per kilogram of paddy (Tsh.)	971.25	864.88	0.04
Average Revenue of paddy per acre	2 342 756.25	2 117 612.50	0.03
Average Cost of all inputs, land renting and irrigation service annually	590 687.50	760 687.50	0.08
Average Cost of labour annually	330 150.00	326 750.00	0.00
Summation of cost for inputs, land renting, irrigation service inputs and labour annually	920 837.50	1 087 437.50	0.05
Net revenue per acre	1 421 918.75	1 030 175.00	0.10
Returns on investment for paddy production	154.42	94.73	0.00

The likely reason for this difference is that farmers in the cooperative scheme start planting their crops earlier than those in the private scheme; hence they can fetch better prices since they manage to sell their produce before bumper period. The farmers in the private irrigation scheme were not allowed to start planting until the investor has planted his crops. This constrains farmers from harvesting their produce early hence fail to fetch better price. Another reason was the location of the two schemes. The cooperative irrigation scheme (Igomero) is closer to the highway of Mbeya to Dar es Salaam, on being found in this location it facilitated farmers from this scheme to sell their produce at slightly higher price since their customer do not incur an extra cost of transporting purchase their produce. However the difference due to location is expected to have low impact as most of the buses do not stop at Igomero, except for some few private cars. This difference could also be due to the fact that farmers in these two irrigation schemes differ significantly in terms of cost of input, land renting cost and irrigation water fees.

Returns on investment for paddy in private irrigation scheme is found to be 94%, while in cooperative irrigation scheme is found to be 154%. The observed difference in returns on investment in the paddy production in the two schemes was found to be statistically significant as shown on Table 13.

Hence based on the above findings the null hypothesis two which stated that “there is no difference in return on investments for paddy production between these schemes,” was rejected based on the observed difference in returns on investments between these two irrigation schemes.

4.3 Effect of Institutional Arrangement on Performance of Scheme

In evaluating the effect of institutional arrangement in management, operation and Maintenance (MOM) on performance of irrigation schemes, the studied factors were grouped in three categories namely physical, Economic and institutional factors.

Table 13 shows that out of 40% scores in physical factors, private scheme have scored 36.11% as compared to cooperative scheme which has scored of 33.69%. Private irrigation scheme was performing better in terms of percentage of irrigation facilities in good conditions, percentage of drainage facilities in good conditions; and actualize rate of irrigation planning. The likely reason for this difference was that, the private company was endowed with capital that enabled them to maintain its irrigation facilities hence most of its drainage was in good condition as well as most of their irrigatable area was being irrigated.

Table 13: MOM physical indicators scores

sn	Indicator	Value of weight(WT)	Value scored by Private irrigation scheme	Value scored Cooperative irrigation scheme
1	Percentage of actual irrigated area, F, (%)	0.08	7.075	7.189
2	Efficiency of irrigation water supply, s (%)	0.06	6.000	6.000
3				
4	Sustainability of irrigated area, Fs, (%)	0.03	3.000	3.000
5	Distribution network density, DND, (%)	0.03	1.997	2.5245
6	Percentage of irrigation facilities in good conditions (QIP), (%)	0.06	3.714	0.9474
7	Actualize rate of irrigation planning, WSE, (%)	0.04	4.500	4.200
8	Percentage of change of water used unit area, FD, (%)	0.03	2.820	2.833
	Project irrigation efficiency, Ep, (%)	0.07	7.000	7.000
	Total physical		36.1063	33.695

Table 14, shows that economic factors carries 40% of total marks, out of this cooperative irrigations scheme score was 37.28% as compared to 30.13% of private irrigation scheme. Cooperative irrigation scheme performed better in term of percentage of the highest total yield, percentage of the highest yield per unit quantity of irrigation water and personnel cost, this is likely due to the reason that they get irrigation timely contrary in private irrigation where unless the investor is enough with water when the rest of irrigators will get irrigation water. Private scheme was doing very well in the collection of fees pertaining to irrigation as well as other revenue apart from water fees, total financial viability and secondary revenue rate. The cooperatives scheme is not doing well in collection of various fees, this can probably be due to the fact that their leaders do not have direct benefit from the collected fees as compared to private scheme management, and also probably they want to please their member for being maintained in management during next election which is done by members.

Table 14: MOM economical indicators scores

s/n	Indicator	Value of weight (WT)	Value scored by Private irrigation scheme	Value scored Cooperative irrigation scheme
1	Percentage of the highest yield per unit quantity of irrigation water, Pyw, (%)	0.05	3.000	6.955
2	Percentage of the highest total yield, Py, (%)	0.10	5.075	8.987
3	Efficiency of collection of irrigation water charges, TE, (%)	0.07	6.650	5.880
4	Total financial viability, TFC, (%)	0.06	5.183	5.426
5	Financial self-sufficiency, Eyy, (%)	0.08	8.000	8.000
6	MOM personnel cost, PGO, (%)	0.02	0.500	1.000
7	MOM secondary revenue rate, IG0, (%)	0.02	1.725	1.034
			30.133	37.283

Table 15, shows that institutional factors which carries 10% of total marks, cooperative irrigation scheme has performed better by scoring 8.64% as compared to private scheme which scored 7.64%. Private irrigation scheme was performing better in term of technical knowledge of staff and percentage of change of personnel number while cooperative irrigation scheme was performing better in term of participation rate of irrigation groups in irrigation scheme maintenance. This finding was contributed by the fact that most of cooperative scheme members were trained on irrigation and agriculture as compared to private scheme as well as nature of cooperative scheme being responsive to members needs. The reason of Private scheme having good technical knowledge staff is due to their ability to pay the staff as they are good in collection of various fees as compared to cooperative irrigation scheme.

Table 15: MOM institutional indicators scores

s/n	Indicator	Value of weight (WT)	Scores for Private irrigation scheme	Scores for Cooperative irrigation scheme
1	Rate of participation of irrigation groups in irrigation scheme maintenance, SGHO, (%)	0.02	1.884	1.975
2	Technical knowledge of staff, TPO, (%)	0.03	2.625	2.499
3	Percentage of change of MOM personnel number, PDY, (%)	0.05	2.709	4.167
	Total institutional arrangement scores		7.641	8.641

The overall performance of these two institutional arrangements shows that Cooperative irrigation scheme performed better than private irrigation scheme, the scores were 84.11% and 78.45% for cooperative and private irrigation scheme respectively (The details of formulation, data specification and calculations of overall weighted average marks is found in Appendix 3). Cooperative irrigation scheme performance is ranked as good, WAM for good ranges from 80 to 89.9 while Private irrigation scheme is ranked as fair,

WAM for fair ranges from 70 to 79.9. The findings also show that “t” test value shows that the difference between the two schemes having P of 0.179716, this implies that this difference is not statistical significant. Hence based on the findings above we fail to reject the null hypothesis three saying that “there is no difference in performance of irrigation scheme under each institutional arrangement.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The findings for objective one of this study which aimed at the evaluation of the institutional and organisation arrangement of the two scheme has found that there is significance difference in organisational and institutional arrangements of the two schemes. Cooperative scheme adopted “bottom up” approach of administration where irrigators are the one who decide what should be done by the management while the private scheme adopted a “top down” administration approach where investor is the one who decides what should be done by staff and other stakeholders. Cooperative irrigation scheme allows more participation of stakeholders in the management and maintenance of scheme facilities hence lead to sustainability as they get feedback hence it is easy to respond to its market demand. Private irrigation scheme should put mechanism of getting feedback from their clients and staff for sustainability, some of way of getting feedback for improvement of their service can be by putting suggestion box as well as doing research on customer satisfaction.

Regression analysis revealed that the two institutions responded differently on the same variables used in testing them. The institutional variables like distribution of tasks, training to stakeholders, enforcement of laws, effectiveness in monitoring and planning in scheme management showed positive contribution in institutional performance of the irrigation scheme. Ineffectiveness in collection of fees and penalties and extent of occurrence of problems/accidents in the process of operations and maintenance of the irrigation scheme has negative impacts on performance on irrigation scheme.

Another difference observed between the two schemes was in their by-Laws. Most of the irrigators in private irrigation scheme claim that laws and by-laws as well as their enforcement are not friendly with them. One of such bylaws is that farmers should not plant their paddy until the investor's paddy has been planted, this aim to avoid competition of water during the period when the investors is planting. This makes them to harvest late hence they do not fetch better prices in the beginning of the season.

Hence base on the findings, both schemes management has to work on enforcement of the laws and regulation of the scheme as they have positive contribution on performance of the scheme as well as having in place best plans and effective monitoring system of the irrigation scheme facilities. Effectiveness in planning and maintenance of the irrigation scheme helps to reduce the number of problems/accidents in the irrigation scheme hence attains the best performance.

The findings for objective two of this study which aimed at comparing returns on investments for paddy production in cooperative and private institutional arrangements showed that the difference in net return was statistically significant. The reason for this difference could be because of the selling price, where the cooperative irrigation scheme fetches better price as compared to private irrigation scheme as the cooperative scheme harvest their crops earlier when the prices were still high contrary to the private scheme where farmers were limited to plant late due to the by-law that they should wait for the investor to plant their crops first. Hence it is important to review such by-laws so as to improve returns for irrigators under the private irrigation scheme.

Studying objective three which aimed at the evaluation of performance of each irrigation scheme under different institutional arrangement was done using weighed average mark (WAM). The indicators were grouped by in physical, economical and institutional indicators. Private irrigation scheme scored better in physical factors, it was performing better in terms of percentage of irrigation facilities being in good conditions and percentage of drainage facilities being in good condition. The likely reason for this difference was that, the private company was endowed with capital that enabled them to maintain its irrigation facilities hence most of its drainage canals were clean as well as using most of their irrigatable area.

In economical indicators, cooperative irrigation scheme performed better in term of percentage of the highest total yield, percentage of the highest yield per unit quantity of irrigation water and personnel cost. Private scheme performed well in the collection of fees pertaining irrigation as well as other revenue apart from water fees, this is because of having a good system for collection of fee before the farmers being allocated cultivation plots.

Cooperative irrigation scheme score higher in institutional factors as compared to private scheme. Cooperative irrigation scheme was performing better in term of participation rate of irrigation groups in irrigation scheme maintenance while private irrigation scheme was performing better in term of technical knowledge of staff and percentage of change of personnel number. This finding was contributed by the fact that most of cooperative scheme members got training on irrigation and agriculture as compared to private scheme as well as nature of communication/relation of stakeholders, cooperative scheme which gives room for to and fro feedback.

Generally the role of institutional arrangement on performance of irrigation scheme has revealed that cooperative institutional arrangement gives good performance as compared to private irrigation scheme, however the difference in performance is found no to be statistically significance. Organisational and institutional arrangement as well as returns on investment was found to have difference which is statistically significant.

5.3 Recommendations

In view of the above discussion and conclusion, it is recommended that

- i. All the irrigation schemes should think of employing an extension worker who will work close to farmers in management and maintenance of the scheme as well as imparting good agricultural practice. The extension services were not found in both irrigation schemes;
- ii. Irrigators hiring plots from private irrigation scheme should consider forming a platform to advise private scheme management in various matters of the pertaining the service they get from the scheme hence increase efficiency in operation and management of the scheme. This argument is supported by the World Bank (2004) which explained that participatory irrigation management promotes greater involvement of applicable stakeholder groups in the establishment, operation, maintain of irrigation systems, collection of fees, increasing efficiency and productivity; for improving accountability, performance and responsiveness to farmers; and for improving the financial sustainability of irrigation systems;

- iii. The mechanism should be put in place to allow irrigators in private scheme to plant their crops early so that they can fetch better prices;

- iv. Cooperative scheme should find the better ways of collecting the revenue from farmers as the current practice of delayed payments may compromise with the sustainability of the irrigation scheme as operational activities which need to be financed are seasonal and time bound, they cannot wait until the farmers decide to pay;

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APPENDICES

Appendix 1: Questionnaires

Introduction

Good morning/afternoon/evening! I am _____ from the Sokoine University of Agriculture, Morogoro, and I am part of a research team conducting a study on the role of institutional arrangement on the performance of irrigation schemes in Tanzania

. I would like to assure you that the information that you will reveal in this interview will be used solely for purposes of research, and that your identity as well as your answers will be treated with confidentiality. In answering my questions, please remember that there are no correct or wrong answers. We are just after your honest opinion.

Questionnaire for Assessment of Demographic and Socioeconomic profile of respondent

1. Gender:

- _____ 1. Male
 _____ 2. Female

2. Age: _____ Years

3. Marital Status:

- _____ 1. Single
 _____ 2. Married
 _____ 3. Widowed
 _____ 4. Divorced

4. Educational attainment (No. of years):

- _____ 1. No formal schooling
 _____ 2. Primary level
 _____ 3. Secondary school level
 _____ 4. Certificate level
 _____ 5. Diploma
 _____ 6. Higher education level

5. Does irrigation management prepare the reports of the financial status and being shown to the stakeholders timely? YES/NO.....

6. Are the accounts of the association audited and presented to the stakeholders? YES/NO.....

7. Have irrigation scheme users gotten any formal training on management of the scheme? YES/NO

8. How do you perceive the distribution of tasks various parts of the structure the main institutional involved? (X₁)

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

9. To what extent do the other institutions involve in Management, operation and maintenance of the irrigation scheme? (X_2)

organisation	Rate of involvement				
	1. Very often	2. Often	3. Normal	4. Rare	5. Very rare
WATER USER ASSOCIATION (WUA)					
Cooperative society					
Nongovernmental organisation (NGO)					
WUA Apex					
Government					
Private company					

10. How do you define interconnections/cooperation between these institutions? (X_3)

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

11. How do you perceive the importance of rules/bylaws/regulations and policy managing irrigation scheme? (X_4)

1. Very important	2. Important	3. Normal	4. Less important	5. Much less important

12. How do you rank the activism in enforcing laws and bylaws/regulation governing the irrigation scheme? (X_5)

1. Very active	2. Active	3. Normal	4. Bad	5. Very bad

13. Is there an effective monitoring and planning system in the organizations? (X_6)

1. Much agree	2. Agree	3. Normal	4. Disagree	5. Very disagree

14. How is the irrigation scheme management effective in collection of fees, penalties and other charge from irrigators? (X_7)

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

15. What is the extent of problems/accident arising due to the negligence of management occur? (X_8)

1. Very often	2. Often	3. Normal	4. Rare	5. Very rare

16. Various produce grown in the irrigation scheme, their yield, sale price, input price, labour and its cost and revenue got analysis per ha (X_9)

VARIABLE	PADDY	MAIZE	MILLET	GROUND NUTS	CROP1	CROP2	CROP3	CROP 4
Yield in season (kg/ha)								
Crop Sale price (Tsh kg ¹)								
Quantity of inputs used ((kg or Lt)								
Inputs Price used for production of crop I (Tsh kg ⁻¹ or Lt ⁻¹)								
The total amount of labour used (in man days)								
Local wage rate which is same for all households and all crops (Tsh man day ⁻¹).								
Net revenue from sales of different crops (in Tsh/ha)								

17. Is there a participation of the target groups (water users) in the organization?

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

18. How do you rank the performance of current management in running the irrigation scheme? (Y)

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

19. How do you perceive the organization structure of the structure the main institution involved?

1. Very good	2. Good	3. Normal	4. Bad	5. Very bad

THANK YOU FOR YOUR COOPERATION

Appendix 2: Checklist

CHECK LIST TO BE ADMINISTERED WITH RESEARCHERS HIMSELF TO INSTITUTIONAL MANAGEMENT AND KEY INFORMANTS IN FOCUS GROUP DISCUSSION

1. What is the total area planned to irrigate last season?.....
2. What is the actual area you are now irrigating which is irrigated?.....
3. What is your annual requirement of irrigation water in a year (m³/year)?.....
4. What is the annual availability of irrigation water in a year?..... (m³/year)
(Information number 3 and 4 can be found from district agriculture office and Uyole research centre)
5. What is currently irrigable area?
6. What is initial irrigated area?
7. What is the total length of distributor canals in irrigation scheme?
8. What is the total length of conveyance and distributor canals in the same irrigation scheme?
9. What is the total number of structures for drainage scheme in a particular category (main, secondary, tertiary drainage canals)?
10. What is the total number of structures in good condition (safe, integrated, functioning normally).....
11. What is the total number of structures for drainage scheme in a particular category (main, secondary, tertiary drainage canals)?
12. Total number of structures in good conditions irrigation scheme in a particular category (main, secondary, tertiary drainage canals)?
13. What is the quantity of water volume that the associations/management intended to supply according to irrigation planning (m³/year)?
14. What is the water used in unit area (ha) (m³/year)?
15. What is the amount of water used in unit area in the historical (m/ha/historical year)?
16. What is the amount of water used in unit area in the historical (m/ha/historical year)?
17. What is the crop irrigation water requirement in project area (m³/year)?
18. What is total inflow into canal system (m³/year)?
19. What was the annual average depth of groundwater table last year (m)?
20. What is the annual average depth of groundwater table this year (m)?
21. What is the total annual yield (ton/year)?
22. What is the yield per unit quantity of irrigation (ton/m³)?
23. What is the historical highest annual yield per unit quantity of irrigation water ton/m³)?
24. What is the total annual yield (ton/year) of crops in project area (ha)?
25. What is the historical highest total annual yield in the whole irrigation district (ton/year)?.....
26. What are the irrigation charges due in the whole irrigation district?
27. What is the total the irrigation charges collected (Tsh)?
28. What are total requirements (cost) for irrigation schemes and management?
29. What is the actual Management, Operation and Maintenance (MOM) allocation?
30. What is the personnel cost in the year researched, (TSH\$/year)?
31. What is the total MOM cost, (TSH\$/year)?
32. What is the total MOM revenue actualized in the year (TSH\$/year)?

33. What is the revenue except for irrigation charges (TSH\$/year)?
34. What is the area operated by irrigation groups (ha)?
35. What is planned irrigation area (ha)?
36. What is the number of staff with knowledge required to fulfil the MOM service?
.....
37. What is the total number of staff in the irrigation scheme?
38. What is the current number of personnel with knowledge required to fulfil MOM
services?
39. What is the current number of personnel fulfilling MOM services?
40. What is the current number of personnel with knowledge required to fulfil MOM
services?

Appendix 3: Weighted average marks formula and calculations

Method of calculating the weighted average mark of the index system for a given institutional arrangement the place, the WAM was calculated by the model:

$$WAM = \sum (ID_i * WT_i) + \Delta MK1 + \Delta MK2 + \Delta MK3 + \Delta MK4$$

Source: (Akar and Ozdmer, 2007)

Where:

$\Delta MK1$, $\Delta MK2$, $\Delta MK3$ are the additional marks. If the management organization sound and the great majority of peasant management personnel have been trained, $\Delta MK2 = 4$. If the records, tables and charts of management are complete, $\Delta MK1 = 2$. If the advanced technique has been applied and proved to be effective, $\Delta MK3 = 4$.

If it doesn't accord with the above respective demands, $\Delta MK1$, $\Delta MK2$, and $\Delta MK3$ are equal to zero.

$\Delta MK1$ is the deduction of marks due to an accident arising from the negligence of management personnel. The values of $\Delta MK1$ are as follows;

For ordinary accident; $\Delta MK1 = 2.0$ ($A > 100$ ha), $\Delta MK1 = 1.5$ ($A = 100 - 1000$ ha), $\Delta MK1 = 1.0$ ($A > 1000$ ha). For serious accident; $\Delta MK1 = 10.0$ ($A > 100$ ha), $\Delta MK1 = 7.5$ ($A = 100 - 1000$ ha), $\Delta MK1 = 5.0$ ($A > 1000$ ha).

The standard for evaluating the irrigation performance in a given institutional arrangement under this model is ranked using weighted average marks (WAM) as per the following classification; WAM = 90-100 Excellent, WAM = 80-89.9 Good, WAM = 70-79.9 Fair, WAM = 60-69.9 Bare and WAM < 60 Poor.

For private company irrigation scheme calculations of weighted average mark of the index system for a given institutional arrangements:

Where:

$\sum (ID_i * WT_i)$ value is 73.45

$\Delta MK1 = 2$ as records, tables and charts of management are complete.

$\Delta MK2 = 4$ as the management organization sound and the great majority of peasant management personnel have been trained.

$\Delta MK3 = 0$ as the advanced technique has not been applied and proved to be effective.

$\Delta MK^1 = 1.0$ is the accident arising from the negligence of management personnel for ordinary accident is and the area is above 1000ha.

Hence value of WAM for private managed irrigation scheme is found by substituting the values in the above formula which gives the following

$73.45 + 2 + 4 + 0 - 1 = 78.45$ this value is in the range of WAM = 80-89.9 which is ranked as Fair (70%-79.9%)

For cooperative water user irrigation scheme calculations of weighted average mark of the index system for a given institutional arrangements:

Where:

$\sum (ID_i * WT_i)$ value is 79.61

$\Delta MK1 = 2$ as records, tables and charts of management are complete.

$\Delta MK2 = 4$ as the management organization sound and the great majority of peasant management personnel have been trained.

$\Delta MK3 = 0$ as the advanced technique has not been applied and proved to be effective.

$\Delta MK^1 = 1.5$ is the accident arising from the negligence of management personnel for ordinary accident is and the area is below 1000ha.

Hence value of WAM for private managed irrigation scheme was found by substituting the values in the above formula which gives the following

$79.61 + 2 + 4 + 0 - 1.5 = 84.11$ this value is in the range of WAM = 80-89.9 which is ranked as good.

Formula and calculations of weighted average mean for private irrigation scheme

s/n	Indicator	Value of weight (WT)	Process and results of calculating indices	Process and results of calculating (MK=mark) marks	Weight calculation, (MK)	Value (WT*VALUE)
I. MOM Physical Indicators						
1	Percentage of actual irrigated area, F, (%):	0.08	$F = 3015/3200 \times 100\% = 94.21$	$MK = 2 * 94.21 - 100 = 88.44$	$88.44 * 0.08$	7.0752
2	Efficiency of irrigation water supply, s (%)	0.06	$S = 6/8 * 100 = 75$	$S \geq 100; MK = 100,$ $S < 100; MK = S$	$100 * 0.06$	6
3	Sustainability of irrigated area, Fs, (%)	0.03	$FS = 3200/1170 \times 100\% = 273.50$	$FS \geq 100; MK = 100$	$100 * 0.03$	3
4	Distribution network density, DND, (%)	0.03	$DND = 13.73/20.70 \times 100\% = 66.57$	$MK = DND = 66.57$	$66.57 * 0.03$	1.9971
5	Percentage of irrigation facilities in good conditions (QIP), (%)	0.06	$QIP = 17/21 \times 100\% = 80.95$	$MK = 2 * 80.95 - 100 = 61.90$	$61.90 * 0.06$	3.714
6	Actualize rate of irrigation planning, WSE, (%)	0.04	$WSE = 6/8 \times 100\% = 75$	$WSE > 100; MK = 150 - 0.5 * 75 = 112.5$	$112.5 * 0.04$	4.5
7	Percentage of change of water used unit area, FD, (%)	0.03	$FD = 2.2/2.5 \times 100\% = 113.64$	$FD \leq 100; MK = 50 + 0.5 * 113.64 = 94$	$94 * 0.03$	2.82
8	Project irrigation efficiency, Ep, (%)	0.07	$Ep = 4/6 \times 100\% = 33.33$	$EP \leq 25 \quad MK = 50; 26 \leq EP \leq 35 \quad MK = 70$ $36 \leq EP \leq 45 \quad MK = 80;$ $46 \leq EP \leq 55 \quad MK = 90; 56 \leq EP \leq 65 \quad MK = 100$	$100 * 0.07$	7
						36.1063

II MOM Economical Indicators						
9	Percentage of the highest yield per unit quantity of irrigation water, Pyw, (%)	0.05	$Pyw = 2.01/2.51 \times 100\% = 80$	$MK = 2 \times 80 - 100 = 60$	60×0.05	3
10	Percentage of the highest total yield, Py, (%)	0.1	$Py = 12\ 060/16\ 000 \times 100\% = 75.38$	$MK = 2 \times 75.38 - 100 = 50.75$	50.75×0.1	5.075
11	Efficiency of collection of irrigation water charges, TE, (%)	0.07	$TE = 389\ 538\ 000 / 410\ 040 \times 100\% = 95$	$MK = TE = 95$	95×0.07	6.65
12	Total financial viability, TFC, (%)	0.06	$TFC = 53\ 559\ 300 / 62\ 000\ 000 \times 100\% = 86.39$	$TFC < 100; MK = FC = 86.39$	86.39×0.06	5.1834
13	Financial self-sufficiency, Eyy, (%)	0.08	$Eyy = 389\ 538\ 000 / 53\ 559\ 300 \times 100\% = 727.30$	$EYY < 100; MK = EYY$ $EYY > 100; MK = 100$	100×0.08	8
14	MOM personnel cost, PGO, (%)	0.02	$PGO = 10\ 690\ 000 / 53\ 559\ 300 \times 100\% = 19.96$	$35 < PGO;$ $MK = 50;$ $50 > PGO; MK = 25$	25×0.02	0.5
15	MOM secondary revenue rate, IGO, (%)	0.02	$IGO = 335\ 978\ 7000 / 389\ 538\ 000 \times 100\% = 86.25$	$MK = IGO = 86.25$	86.25×0.02	1.725
III MOM Institutional Indicators						
16	Rate of irrigation groups in irrigation scheme, SGHO, (%)	0.02	$SGHO = 1352/3200 \times 100\% = 42.31$	$MK = SGHO = 42.31$	42.31×0.02	0.8462
17	Technical knowledge of staff, TPO, (%)	0.03	$TPO = 6 / 8 \times 100\% = 75$	$TPO \leq 100; MK = 50 + 0.5 \times 75 = 87.5$	87.5×0.03	2.625
18	Percentage of change of MOM personnel number, PDY, (%)	0.05	$PDY = 5 / 6 \times 100\% = 66.67$	$PDY \leq 100;$ $MK = 50 + 0.5 \times 66.67 = 83.33$	83.33×0.05	4.17

Appendix 4: Finding for objective 2 and 3

RETURNS ON INVESTMENT FINDINGS FOR OBJECTIVE 2

t-Test: Two-Sample Assuming Equal Variances

	<i>PRVT</i>	<i>WUA</i>
Mean	105.170906610	171.1593615
Variance	10,641.684694860	9486.989502
Observations	80.000000000	80
Pooled Variance	10,064.337098623	
Hypothesized Mean Difference	0.000000000	
Df	158.000000000	
t Stat	-4.160115303	
P(T<=t) one-tail	0.000026034	
t Critical one-tail	1.654554876	
P(T<=t) two-tail	0.000052069	
t Critical two-tail	1.975092037	

OBJECTIVE 3

INSTITUTIONAL PERFORMANCE

t-Test: Paired Two Sample for Assuming Equal Means

	<i>WUA</i>	<i>PRIVATE</i>
Mean	4.42325	4.080978
Variance	6.65836288	4.771363
Observations	18	18
Pearson Correlation	0.80309523	
Hypothesized Mean Difference	0	
Df	17	
t Stat	0.94196859	
P(T<=t) one-tail	0.1797016	
t Critical one-tail	1.73960672	
P(T<=t) two-tail	0.35940321	
t Critical two-tail	2.10981556	