International Journal of Asian Social Science
ISSN(e): 2224-4441/ISSN(p): 2226-5139
URL: www.aessweb.com

PERFORMANCE OF WATER MANAGEMENT INSTITUTIONS IN FARMER-MANAGED IRRIGATION SCHEMES IN IRINGA RURAL AND KILOMBERO DISTRICTS, TANZANIA

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ABSTRACT

Over-use or mismanagement of water can occur when institutions fail to meet various users' demand. This study evaluate the extent to which water management institutions are effective and legitimate in governing water allocation and distribution in Farmer-Managed Irrigation Schemes in Iringa rural and Kilombero Districts, Tanzania. Institutional performance was evaluated using Ostrom's eight design principles or indicators. Findings indicate that there is significant associations between scheme type (traditional and semi-improved irrigation) and clearly defined boundaries of resource and of appropriators; participation in decision making; collective action and conflict resolution mechanisms. Clearly defined boundaries of resource and users rights', congruence between appropriation and provision rules and local conditions and fair representation in water decision making bodies principles seemed to perform better in the semi-improved irrigation schemes. The traditional schemes seem to have a better grip on monitoring, legitimate sanctions, collective actions and conflict resolution mechanisms that are swift and low-cost efficient. Limited (39%) involvement of farmers in water decisions created a sense of dispossession leading to negative attitudes towards a new water management institution. This study underscores the importance of local water users' participations in water management decision bodies in order to come up with effective, cost efficient and legitimate formal institutions. Formalization of any water management institutional interventions by policy makers should build on the existing informally established regulations and take into account local conditions.

Keywords: Irrigation, Design principles, Institutions, Institutional bricolage, Smallholder farmers, Water management.

Contribution/ Originality

The paper's primary contributions is finding that the current formal integrated water resource management institutions perform inefficiently due to failure of policy makers to recognize and incorporate the role played by informal institutions. Integrating formal and informal aspects will emanate with robust and long enduring institutions.

1. INTRODUCTION

Developing nations have embraced decentralization as a means to increase equity, efficiency and sustainability in the governance of natural resources, including water (Böcher, 2012). In Sub-Saharan Africa (SSA), many countries went through a dramatic transformation in the water institutional framework after the International Conferences on Water and Environmental Issues held in Dublin and in Rio de Janeiro, Brazil (1992). Since then, water policy reforms have been adopted by various countries and international programmes (e.g. Global Water Partnership) as a way to reduce the public financial burdens and promote sound management of water (Merrey and Cook, 2012; Meinzen-

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DOI: 10.18488/journal.1/2016.6.8/1.8.430.445
ISSN(e): 2224-4441/ISSN(p): 2226-5139

Dick, 2014). In light of this, a revision of the national water policy framework in developing countries to adopt the concept of Integrated Water Resources Management (IWRM) was a condition of the World Bank's loan (Van Koppen and Tarimo, 2014).

IWRM aims at enhancing water users' capacity to cordially develop, manage and share water resources efficiently. The emphasis of IWRM is centred on four key principles namely: management of water based on hydrological boundaries — the catchment and sub-catchment areas; decentralization; treatment of water as an economic good; and stakeholder participation through representation in water management decision making. The expectation is that delegation of power and responsibilities to the river basin officers and water users will not only encourage sustainable use and conservation of water resources, but also improve community livelihoods (Huang *et al.*, 2010; Araral and Wang, 2013).

In Tanzania, the notion that water should be governed by formalized principles of IWRM is integrated in the National Water Policy of 2002 and the Water Resource Management Act No. 11 of 2009. Following this, water management has been effected through basin level negotiations and co-ordination, legal instruments including redesign of property rights, water permits, cost recovery regulations and transfer of part of the irrigation management to local users' associations (Maganga *et al.*, 2004; URT, 2013). Availability of water and user access is ultimately a function of institutions and organizations coordinating and regulating water supply and management (Ostrom, 1990; Cleaver, 2002; Cleaver, 2012).

Studied conducted in management of Common Pool Resources (CPRs) including water (Mbeyale, 2009; Ostrom and Basurto, 2011) show that if the resource is mismanaged or depleted, the problem might be attributed to the fact that institutions do not fit well to the characteristics of the resource or to the users of the resource. This implies that available institutions are not performing adequately. According to Ostrom (1990) CPR is "a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use". Any individual or group of appropriators withdrawing resource units from the CPR are governed by exclusionary principles (Ostrom, 1990; Vatn, 2005). There is rivalry in consumption of water that needs to be controlled by resource institutions and users. This means that the resource units taken by an individual or group reduce its availability to other users. CPR system has a structured ownership arrangement within which rules are developed and enforced, group size is known, and incentives exist for co-owners to follow accepted institutional arrangements. Such social arrangement regulating the maintenance and consumption of CPR is termed as common property regime (Ostrom, 2003). Irrigation schemes, fishing grounds, grazing lands, underground water and forests by their nature are examples of CPRs.

According to Kamran and Shivakoti (2010) an irrigation scheme is a "Social-Ecological System (SES)" - a complex collection of human, physical and institutional entities that respond to internal and external factors through a diverse array of rules. For the purpose of this paper institutions are formal (written rules and procedures) and informally established procedures, norms, practices and patterns of behaviors that shape human interactions in management and use of water (North, 1990; Cleaver, 2012).

The potential of water governance institutions in keeping the common pool characteristics of irrigation schemes and their sustainability is no doubt substantial, but their success in performing their duties differs from country to country and among macro, meso and micro levels. There are some settings where appropriators are able to self-organize successfully and other settings where they are not. Despite the adoption of IWRM principles, overuse and mismanagement of water, competition and conflict over water are common challenges in Farmer-Managed Irrigation Scheme (FMIS) (Sokile *et al.*, 2005; URT, 2008; Patel *et al.*, 2014; Mosha *et al.*, 2015). These challenges translate to one central question: are the water management institutions in-use achieving the desired performance?

A number of studies (e.g. (Ostrom, 2001; 2008; Franks *et al.*, 2013)) show that introduced water rights and cost recovery regulations have improved the timeliness of water deliveries. Other studies show a weak association between people participation in decision making and access to water (Saleth and Dinar, 2004; Swatuk, 2005; Huang *et al.*, 2010). However, there is little consensus about other aspects or performance indicators. In addition, Regmi

(2008) argued that predicting good performance or lack of performance simply by looking at the presence or absence of a set of institutions is not recommended. Actually to promote introduced IWRM principles, a thorough understanding of their performance in governing the process of water allocation and distribution is necessary. Such understanding is essential to inform policy makers and water managers to design water policies that would strengthen institutional capacities in managing water. It is against this background that the study to evaluate the performance of water management institutions was undertaken. The paper attempts to report findings on the performance of water management institutions in Farmer-Managed Irrigation Schemes (FMISs) in Iringa Rural and Kilombero Districts, Tanzania. Specifically, the paper first discusses existing institutional arrangements governing water allocation and distribution in the FMISs. It then ascertains and explicates the performance of water institutions in both traditional and semi-improved FMISs based on Ostrom (1990) eight design principles.

2. CONCEPTUAL FRAMEWORK AND INSTITUTIONAL THEORIES

2.1. Conceptual Framework

The conceptual framework is based on the notion that irrigation schemes as CPR are subjected to different water users and resource use institutions (Fig.1). Water users (individuals or collective groups) withdrawing water from resource systems are governed by exclusionary principles (Katani, 2010). These comprise specific institutions (rules in use, social values, norms and practices) and given conditions in terms of user-specific costs and returns associated with the resource regime.

It is assumed that institutions or regimes for water allocation and distribution will be influenced by the characteristics of the resource and by the resource users. Water users have their capacities, experiences and motivations that make any institution work. A core aspect in relation to the framework concerns the pattern of the interactions between the institutions, user attributes and the characteristics of the resource (Young, 2008) which yield outcomes. Outcomes appear as a consequence of the choices made by several agents (individuals, groups and the state) and the influence of institutions. If institutional attributes do not fit users' demands and expectations, problems may occur. According to Vatn (2005) this is also a question about the general legitimacy of the regime and social coherence of the group involved. This may occur in both traditional and improved FMISs with regard to both formal and informal rules. In this study, Ostrom's eight design principles (Box 1) are not only used to test whether or not the institutions fit the irrigation schemes, but also to test how institutional performance differs between traditional and semi-improved FMISs.

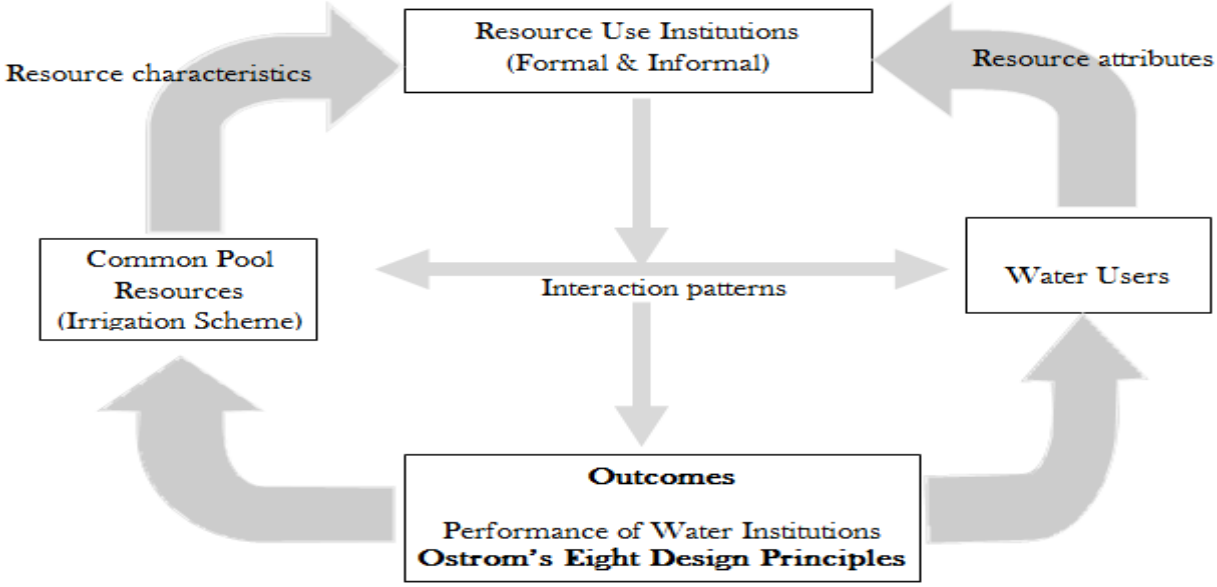

Figure-1. Conceptual framework for analyzing water management institutional performance

Source: Authors Construct (2013)

Box-1. Design principles for effectiveness of CPR institutions

1.	Clearly defined boundaries of resource appropriators as well as the CPR itself
2.	Congruence between appropriation and provision rules and local conditions
3.	Fair say in decision making
4.	Collective action
5.	Monitoring
6.	Graduated sanctions by other appropriators and by officials accountable to appropriators
7.	Conflict resolution mechanisms
8.	Nested enterprises: describes the multiple levels of institutions that are present in CPR regimes

Source: Ostrom (1990)

2.2. Design Principles: Evaluating Institutional Performance of Common Pool Resource

Since the early 1990s, the challenges of overuse of water have been dealt with through reforms of water institutional frameworks emphasizing the implementation of IWRM principles. To obtain information on the extent to which introduced water rules are achieving the expected performance, a set of performance indicators has been agreed upon (Ostrom, 1990; IWMI, 2000). Performance indicators make it possible to compare the performance of different projects and management mechanisms including institutions. The International Water Management Institute (IWMI, 2000) describes performance indicators as tools for measuring the relative performance of irrigations or tracking of an individual irrigation systems. Such indicators are also needed for the proper evaluation of policy alternatives of the CPRs. An important aspect in explaining how institutions operate in case of the management of CPR including water, is illustrated by the work of both mainstream and critical institutionalists (see for example (Ostrom, 1990; Cleaver, 2012; Huntjens *et al.*, 2012; Forsyth and Johnson, 2014). A core common aspect is gains that arise from co-operative institutions. Ruttan (1998) hypothesised that CPR institutions follow principles "restraint for gain". That is if users are able to agree and adhere to what rules should be operative, it becomes possible to take advantage of such renewable resources. Against this backdrop, Ostrom's research works came up with eight 'Design Principles' or conditions as indicators for sustainability of CPR (Box 1).

Despite Ostrom's explicit denial that the design principles should be used as blueprints, they are frequently reiterated and also elaborated further in the literature (Merrey and Cook, 2012). The principles are directly translated into policy and project documents as guidance for action. In a nut-shell, these are similar to important features of IWRM. Farmers' opinion on the legitimacy and effectiveness of water management institutions was therefore evaluated on the basis of the design principles for long-enduring irrigation management systems.

Although the design principle is a substantial model for evaluating institutional performance of CPRs, it concentrates specifically on the internal arrangements and it gives less attention to external influences (Katani, 2010). The model is not appropriate for measuring the satisfaction level of the communities, their ability to adopt, modify and change external interventions. Cleaver and Toner (2006) argue that different local resource users are likely to apply their knowledge, power, networks and agencies with respect to social relations in collective actions in diverse ways. It is further argued that social capital is a crucial institutional resource bank from which arrangements can be drawn that reduces the social overhead costs of cooperation (Regmi, 2008; Cleaver, 2012). According to Komakech *et al.* (2012) the shape of institutions and the nature of management regimes can be seen, at least partly, as functions of the origin of ideas or experiences around the need for effective conservation of resources. Normally, the state fails to recognize the informal arrangements which are paramount social capitals that operate silently, but that influence natural resource planning, management and utilization. In view of these, this study, therefore tries to combine design principles and bricolage institutional theories to ascertain the realities of institutional arrangements on the ground.

Institutional bricolage is a process through which actors consciously and unconsciously reshape or piece together different arrangements at hand to form new institutions (Cleaver, 2001; Cleaver, 2012). It recognizes the agency of individual actors in negotiating, transforming and adapting newly introduced institutions, including IWRM principles in the management of CPRs.

3. METHODOLOGY

3.1. Study Areas

The study was conducted in Iringa Rural and Kilombero Districts in Tanzania. The two districts were selected because being among the potential areas for irrigated paddy production in Rufiji River Basin (RRB). Although both districts are dominated by irrigation farming, they represent slightly different in terms of weather conditions, water availability and farming systems. It was assumed that the selected districts would provide the best sites for understanding institutional performance at community level. Four FMISs were selected, namely: Mlenge semi-improved (Itunundu village) Mkombozi traditional (Mboliboli village), Mkula (Mkula village) and Magombera-Kibyoko traditional (MAKI) (Mangombera village) (Fig.1). Table 1 shows key attributes of the irrigation schemes in the study areas.

Table-1. Sampled study cases and their status of irrigation systems

District	Ward	Scheme	village	Status of irrigation structures
Iringa Rural	Itunundu	Mlenge semi-improved	Itunundu	Semi-improved FMIS. An intake and main canal of 1.6 Km out of 45 Km are constructed. The scheme has a total of 4 217 ha that serves 7 villages in Pawaga division. The scheme is fed by Little Ruaha river.
	Itunundu	Mkombozi traditional scheme	Mboliboli	Traditional FMIS. No improved irrigation infrastructures. It has about 3 000 ha, which serves about 1 700 farm households in Mboliboli village. This scheme is also fed by the Little Ruaha river
Kilombero	Mkula	Mkula semi-improved	Mkula	Semi-improved FMIS. Intake and main canal - about 4.8.km constructed. It has 254 ha that serves 324 farm households. Mkula scheme is fed by Mkula river.
	Mkula	MAKI traditional scheme	Magombera	MAKI is a traditional FMIS, with an unimproved irrigation system. It has about 320 ha that provide benefits to 294 farm households in Magombera village, and more than 30 in Kibyoko sub village of Mkula village. The MAKI scheme is partly fed by the Mkula, Sonjo and Msufini rivers

Source: Survey Data (2013)

Iringa Rural District covers 20 576 km^2 out of which 19 877.5 km^2 are land surface and 678.5 km^2 are water bodies. Weather in Iringa Rural varies with altitude and closely associated with two distinctive landscape zones – midland and lowland. The annual rainfall in midland ranges between 1000 and 1 600 mm and a day temperature is as low as 15^0C – 20^0 C. Moreover, the selected villages (Itunundu and Mboliboli) lie in the lowland (northern) zone which is characterised as semi-arid or marginal areas. The annual rainfall in this zone ranges between 500 and 600 mm, and daily temperature is high ranging between 20^0C and 25^0C. Rainfall fall a uni-modal season extending from December to April. According to NBS and OCGS (2013) Iringa Rural District has a total population of 254 032 people. Population density is 12.3 people per km^2 and an average household size of 4.2.

Kilombero district lies along the Kilombero valley with an area of 14 918 km^2 of which 13 577 km^2 are arable land and 1341 km^2 are water bodies. The rainfall regime in the district is bimodal, with a short and a long rainy season. The short rains occur between November and January, whilst the long rains are between March and May. It has an annual rainfall ranging between 1 200 and 1 600 mm. According to the 2012 Tanzania population and housing census, there are 407 880 people and a population density of 27.3 people per km^2. The average household size is 4.3 (NBS and OCGS, 2013).

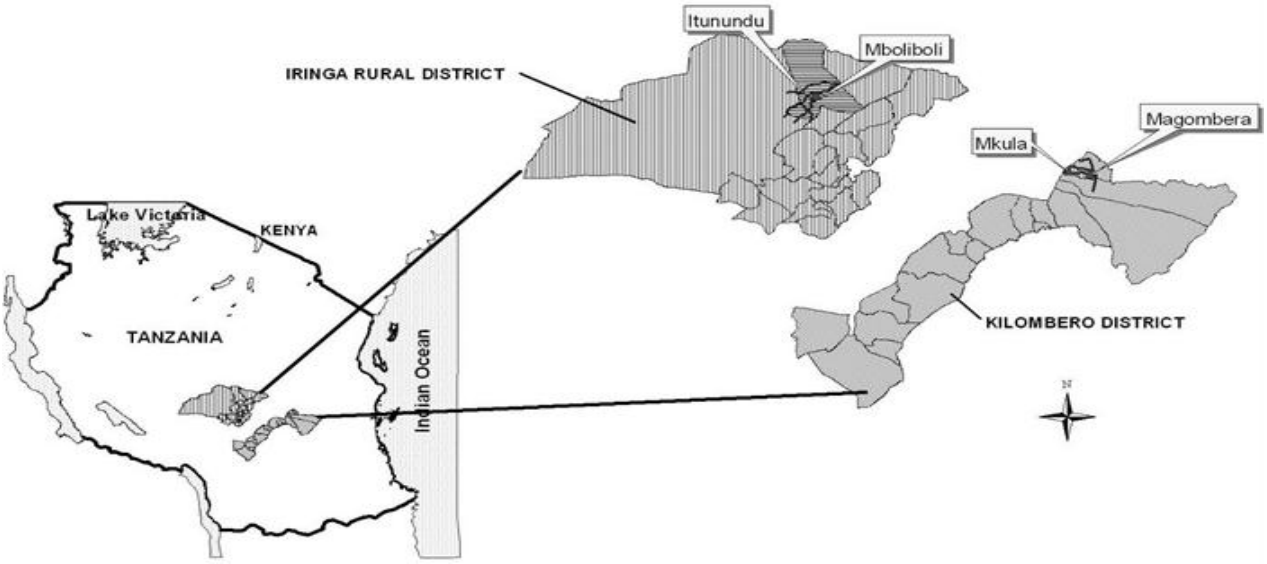

Figure-1. Map showing location of the study districts and villages
Source: Adopted and modified from NBS and OCGS (2013).

3.2. Research Design, Sampling Procedure and Sample Size

A cross-sectional research design which allows collection of data in multiple cases at once was adopted in this study. The study sample was obtained through multiple sampling techniques and stages. The first stage was purposively selecting of one ward per district based on the presence of FMISs. The second stage involved purposive selection of two FMISs from each ward making a total of four FMISs. The third stage involved selection of one village from each FMIS. Two villages per district were thus selected. The two villages selected per district were based on the fact that they were located on the same agro-ecological zone for easy accessibility and similarities in agro-ecological conditions; one had a traditional and the other had semi- improved FMISs and common on a core irrigated crop.

The last stage involved random selection of 172 household heads from the sampling frame of the four FMISs (Table 2). The sampling unit was a household which is engaged in FMIS. The sample size was determined based on Bailey (1994) argument that regardless of the population size, a sample of 30 respondents is the bare minimum for studies and is appropriate for statistical data analysis.

Table-2. Sampled households in study cases in Iringa Rural and Kilombero District (2013)

District	Village	Household # in village	Scheme	Household # in scheme	Sampling intensity	Sample size
Iringa Rural	Mboliboli	1 300	Mkombozi	930	7%	60
	Itunundu	1 610	Mlenge	854	6%	50
Kilombero	Mkula	322	Mkula	322	10%	32
	Magombera	294	Magombera	294	10%	30
Total		3 526		2,400		172

Source: Survey Data (2013)

3.3. Data Collection and Analysis

The study combined three data collection methods: a household survey, Focus Group Discussion (FGD) and direct observations. A household survey involves researcher conducting face to face interviews with 172 household heads using semi-structured questionnaire. Where the head was not available for the study period, spouses were interviewed. The interview questionnaire captured respondents' bio-data and opinions on performance of water institutions using Likert scale statements constructed on the basis Ostrom's eight institutional design indicators. Respondents' responses were assigned weights on whether strongly disagree, disagree, undecided, agree or strongly

agree with statements related to institutional performance. Since this was a semi-structured interview, there was opportunity to ask questions in a flexible way and to follow up on previously identified themes.

In addition to household survey, one Focus Group Discussion (FGD) in each village was conducted. FGD comprising 12 members (6 water users, 2 village leaders, 3 leaders of water user groups and 1 village agricultural officer) as recommended in the literature (Maxwell, 2013). The composition of a group in terms of sex, age and class was taken into account. In the FGDs, issues over rules in use and their performance, conflicts and constraints of water allocation and distribution were discussed. The FGD further helped to verify and validate the survey data. Discussions were recorded using notebooks and a digital recorder to enable precise transcriptions later on.Quantitative data were analysed using the Statistical Product and Service Solutions (SPSS) programme (Version 18). In order to determine levels of association and significance between performance of institutional indicators and scheme types (Objective 2) a Chi-square Test of Independence (Pearson) was adopted. The study hypothesized that performance of eight design principles differed between the scheme types. All independent variables (institutional indicators) recorded at ratio (scale) level were correlated with dependent variable (scheme types) and run to check if it meet the assumption of a Chi-square test. No cell is expected to have a frequency of less than 5; in this case assumption was violated by some statements. Therefore the five likert scale level was merged to 2 levels (Agreed and Disagreed). Qualitative data were analyzed using content analysis. The analysis helped to reduce the volume of recorded information to a set of categories that represent some characteristics of the research objective.

4. RESULTS AND DISCUSSIONS

4.1. Existing Institutional Arrangements Governing Water Management in the Fmiss

The general purpose of water management institutions is to organize the provision of water so as to accord with the collective needs of water users and at the same time to secure a sustainable use of the resource. Table 3 presents the existing formal and informal institutions, key actors and entities responsible for irrigation water allocation and distribution in the FMISs.

Table-3. Existing formal and informal institutions in Iringa and Kilombero Districts

Institutions and entities	Description
Formal institutions	At National level: Water policy of 2009 and Water Resource Management Act No. 11 of 2009. highlight the use of water permit, water rules, cost recovery regulations and court law
	At scheme level: There are irrigators water users' associations having constitutions consisting bylaws/rules/penalty and membership. For example: Membership is only to a person who lives in a village or water body system, aged above 18 years and owns a plot within the irrigation scheme and it is by fee contribution
	Contribution for association costs e.g. entry and registration fee of 10 000 TZS
	Water distribution schedules
Informal institutions	Communal labor for canal and intake maintenance Farm neighbourhood groups
	In Iringa District, marginalize farmers (e.g. elders aged over 60 years) access irrigation water freely and are excused from collective action.
Entities and actors	Rufiji Basin Water Offices (RBWOs), Tanzania Electric Supply Company Limited (TANESCO), District councils, District natural resource officers and irrigation engineers Non-Government Organizations (NGOs), Community-Based Organizations, Village councils, village government leaders, WUAs, Irrigators' associations and farmers

Source: Survey Data (2013)

4.1.1. Formal Institutions

The National Water Policy of 2002 and Water Resources Management Act No. 11 of 2009 are paramount legal institutions formally governing water management and use in Tanzania. The legal institutions provide the overall context within which rules and regulations are constructed and practiced. The new Water Act of 2009 grants water

permits with prioritisation of water for basic human needs and the environment, and subjected to social and economic criteria. The Water Act also provides legal rights and requirements of water users to divert and use water from water resources for irrigation. A water permit is a statutory official certificate issued by the government defining volumetric allocation of water, periods to that particular allocation, abstraction point, and to whom it is provided. In all the study cases, water permits are granted by the Rufiji River Basin Water Offices (RRBWOs) located in Iringa town and Ifakara town - Kilombero District. The study found that the amount charged per scheme by the RRBWO varies. For example, in the 2013 cropping season, Mlenge FMIS paid TZS 3 700 000/-; Mkombozi paid 2 700 000/- and the other two scheme each paid 108 000/- per year. The difference may be explained by attributes of the number of water users and area under irrigation (section 3.4).

The irrigators in the four cases studied are granted permits to use water if they are willing to pay the water fee, which is normally paid after harvest. In Kilombero schemes, permit to irrigate is offered throughout the year enabling farmers to irrigate in dry and wet seasons. This is contrary to the study cases in Iringa Rural District whereby the permission to use water is only from 31st December to 20th July every year. The permits do not allow irrigation in dry season. Ideally, water is made available for downstream use for hydropower generation at Mtera plant and biodiversity maintenance at Ruaha National park.

As presented in Table 3, there are by-laws including conditions for membership, cost recovery system and graduated sanctions guiding farmers in water allocation and distribution. Some of the by-laws differ between the districts. For example, in Iringa Rural District, farmers were obliged to pay water fee of TZS 10 000/- (US$ 6) per acre per cropping season whereas in the Kilombero District they paid 5% of their total harvest per cropping season. This is a financial mechanism to ensure that individual rights to water are exercised. The funds collected were partly used to pay water fees and partly used for renovation of irrigation structures and operational costs. Moreover, a flat fee is levied in Iringa implying a zero marginal cost for water. The differences from marginal cost pricing do not seem to follow any regular principles and often ad hoc charges are used. Wrong pricing policies for irrigation water have been implicated for the major deficiencies of irrigation systems throughout the developing world (Saleth and Dinar, 2004). The findings suggest that design of incentives that will ensure that full social and economic costs of irrigation water are covered is challenging. There are also operating rules that restrict people to irrigate at night, bathing, washing clothes, utensils and animals watering inside the irrigation canal. Failure to adhere to these regulations was subjected to fines or penalties ranging from TZS 5 000 – 200 000/- (US$ 4 -186).

An issue that created controversy during the FGDs is the transformation of water permit into taxation tool, which is implemented nationwide. About 70% of discussants opposed the pricing of water arguing that water is a fundamental human right and not a commodity to be bought and sold. The rest (30%) of the respondents in favour of water pricing pointed out that water tariffs are meant to improve water allocation and distribution and encourage sustainable water resource's conservation. The latter argument agrees with Tarimo *et al.* (1998) who argued that when water is priced, people have a stronger incentive to use water and to use it more efficiently. However, the experience from the study cases is that water pricing and regulations have not functioned as intended. One member of Mkula scheme said that "payment is a challenge, as some people are not willing to pay unless law enforcement mechanisms are applied". This could be attributed to complaints on limited transparency on financial transactions together with inadequate service provision by irrigator associations. The findings are confirm Saleth and Dinar (2004) argument that market-based policies are unlikely to achieve efficient use of water unless they are linked to institutions capable of implementing, monitoring and enforcing pricing policies at the local and national levels.

4.1.2. Informal Institutions

The term "informal" is often taken to mean unwritten rules. This means that informal rules are implicit in everyday practices. As noted by North (1990) these are often unexpressed cultural norms, taboos and values, customs and practices that are produced and reproduced by a society. Farmers in the schemes applied water rationing system during water shortages as a mechanism to ensure water is equally distribution. There are norms such prohibited

bathing, washing clothes and utensils in the irrigation canals. In Iringa District, marginalized farmers (e.g. elders over 60 years old) access irrigation water freely and are excused from collective actions. Men who their wives are pregnant are also prohibited to join collective work in blocking the temporary intake structure (Mboliboli village) believing that their participation will make the structure unstable and easy wash out. Informal social networks such as neighbourhood farm groups are engaged in ensuring each farmer along the informal group receive adequate water at right time. In addition, the networks help members in communal farm works and social functions (Mosha *et al.*, 2015). Respected elders within the clan and village were mediator during conflict reconciliation. The informal structures create their own rules-in-use and they enforce them. Generally, the informal institutions play a significant role in shaping irrigators behaviour in efficient and fairness in resource use.

4.1.3. Water Administrative Structures

The organizational landscape is rich and diverse, with a range of existing and newly-formed administrative entities available to facilitate the allocation, distribution and use of water. At the basin level, there is RRBWO, responsible for monitoring water resources, identify water users, issuing water rights and bills, collecting water abstractions taxes and mediate water conflict within the basin. By 2015 water management at the district level was organized and supervised by the Department of Agriculture, Irrigation and Co-operation. The irrigation engineers in coordination with other line staff and agencies are responsible for irrigation project development and determination of amount of water required by irrigated crops.

At community level, the village government has long been the major state-related organization responsible for allocating land within the village, monitoring water and solving conflicts (water, land and livestock conflicts). The village government is supported by various functional committees having members from sub-villages/hamlets. There is a particular irrigation village committee that works closely with irrigator associations to coordinate the use and management of irrigation water, and usually concentrates on the core tasks of repair and maintenance of irrigation systems. Informal social networks are also engaged in ensuring that each farmer along the informal group receive adequate water at the right time. The mentioned and discussed institutions, entities and actors, normally form a complex layer of institutional arrangements in the FMISs and often impacted the process of water management and use. To sum-up, the equity performance of the water sector entities is inadequate, because of the unbalance between water supply and demand and poor irrigation infrastructures. As a result, the down-stream users get less water than the upstream ones. The conflicts with respect to water distribution take place in connection with the unequal water availability. The above analysis points out the inefficiency of the water management institutions and organizations reflected in the shortcomings of the water law, policy and administration aspects.

4.2. Effectiveness of Design Principles in Managing Water in FMISs

Table 4 summarizes the Chi-square results in the relationship between scheme type and capacity of each designed institutions in fair say, efficient, legitimacy and at low cost allocation and distribution of irrigation water. A general trend is that four out of eight institutional indicators had significant associations with the scheme types. Rules and regulations for water distribution seems to work better for semi-improved, while conflict mechanisms and sanctions work better for traditional schemes. The next section highlights the performance of each design principle.

4.2.1. Boundaries of Resource and Appropriators

The first design principle assesses whether the physical boundaries of the resource and users who have rights to withdraw resource units from the scheme are clearly defined and known. Results shows that performance of clearly defined boundaries of water extraction and users had a significant association with scheme type ($\chi^2 = 6.864$; $p < 0.015$) (Table 4). The findings revealed that 59% of farmers in the traditional, and 45% in semi-improved FMIS indicated that there was no clear delineation of the resource boundary.

Table-4. Association between farmers' opinions on effectiveness of each design principles and scheme types in Iringa Rural and Kilombero Districts (2013)

Sno	Variables	Scheme type	Disagree	Agree	χ2	P value
1.	Boundaries of resource and users who have right to resource are clearly defined	Semi-improved	45	55		
		Traditional	59	41		
		Total	55	45	6.864	0.015*
2.	Congruence between appropriation and provision rules and local conditions	Semi-improved	15	85		
		Traditional	21	79		
		Total	18	82	0.819	1.365
3.	Fairness in decision making	Semi-improved	42	58		
		Traditional	63	32		
		Total	64	39	10.97	0.004**
4	Collective choice arrangements	Semi-improved	61	39		
		Traditional	17	83		
		Total	27	73	10.462	0.005**
5.	Monitoring system	Semi-improved	26	64		
		Traditional	31	69		
		Total	30	70	1.14	0.566
6.	Graduated sanctions	Semi-improved	26	74		
		Traditional	21	79		
		Total	23	77	0.86	0.650
7.	Conflict resolution mechanisms	Semi-improved	64	36		
		Traditional	45	55		
		Total	54	46	6.105	0.047*
8.	Nested enterprises (hierarchal or interrelated organization levels)	Semi-improved	34	66		
		Traditional	40	60		
		Total	33	63	1.404	0.496

*Significant at the 5%; **Significant at the 1% level.

This principle was uncertain in traditional schemes, attributed by the fact that no clearly defined boundaries of resource. The traditional schemes are composed of a myriad of unlined canals. As a result, people access water from unspecified direction and hence, difficulties in excluding free riders. Lack of clear delineation of the resource boundaries in traditional schemes has negative influence in facilitating people to access water.

Evidence from the MAKI traditional scheme shows that people accessed water from different rivers (Sonjo, Mkula and Msufini), and depended on both informal arrangements with other villagers and formal with village councils. The result is in line with critical institutionalism thoughts, that defining clear boundaries is not easy, as resources frequently overlap administrative boundaries - different villages sharing the same water sources (Cleaver and Franks, 2005). The findings are also consistent when compared to Huang *et al.* (2010) who reported difficulties in delineating natural resources boundaries in Chinese context.

The water appropriators in the FMISs were defined by land ownership. Any person who is 18 years old and above and owns a plot within the irrigation scheme is a member of the association and receive their privileges (services and benefits) as long as he/she complies with the rules and obligations. Most famers seemed to understand the purpose of water permit and fees, but it was still hard for them to adhere to these rules. Not adherence to rules in-use increased transaction costs, led to unequal sharing of benefits (presence of free riders) and less revenue generated. The findings are concordant comparing to previous researches elsewhere which indicated positive impacts of agreed membership rights on efficient water management. For example, Vandersypen *et al.* (2006) found that adopting water rights facilitates respect of other water users through which a user can access water for a particular use without jeopardizing other users' rights. However, Boelens and Vos (2011) criticized that the right and membership parcel is not adequate to ensure that natural resources are optimally and fairly managed.

Nevertheless, this particular study found specific social arrangements were made between pastoralists and farmers coordinated by village councils that enabled pastoralists to access water for their livestock. They established allocation mechanisms among themselves without necessarily having a written document to define volumes. This is a

kind of social rule illustrating how newly established water rights can survive and attain legitimacy if it borrows from past or existing local arrangements. Maganga (2003) found that the failure of both colonial and post-colonial states to acknowledge the role of customary water rights and practices make it difficult to achieve a long enduring water resource regime. Similar findings were reported in other small irrigation schemes in India (MCKay and Kerumane, 2006) Kenya, Zimbabwe, and Ghana (Vandersypen *et al.*, 2006) as well as in Tanzania (Sokile *et al.*, 2005; Patel *et al.*, 2014). Therefore, putting water rights in action would be importantly the central government devolving powers and responsibilities to grassroot users.

4.2.2. Congruence between Appropriation and Provision Rules and Local Conditions

There was significant association between performance of congruent rules in influencing irrigators' access to irrigation water and the scheme type (Table 4). While more than half (58%) of the farmers within the semi-improved schemes showed strong adherence to the congruence design principle, less farmers (32%) among traditional schemes did so. The finding implies that access to water use was partly based on water availability in the rivers, and partly on the terrain, location of the field and status of the infrastructures of the irrigation systems.

It should be understood that though water allocation for irrigation in both districts and scheme types depend on the amount of water available in the rivers, controlled allocation was only applicable for improved schemes because they had head structures with control gates and the main canals are lined with concrete cement several kilometres away from an intake. Since the sampled traditional irrigation schemes (Mkombozi and MAKI) had their physical structures in poor condition, the appropriation rules did not necessarily reflect the local conditions. Farmers erected temporary checks of logs, bushes, stones and bags of earthen materials across the river to divert water into the lead canal. The rest of the irrigation canals are unlined, causing high rates of water losses through seepage, thus lowering efficiency of water distribution. According to farmers, farms near the intakes are often flooded during the heavy rainy seasons. Generally, both farmers and agricultural officers admitted that the traditional system was inefficient, as excessive water were wasted in the fields due to unlined canals and poor land levelling.

4.2.3. Participation and Fair Say in Decision Making

Participation and fairness in decision making emphasizes the desirability of public transparency in decision making arrangements at the lowest possible level. There were a significant association between farmers' perceptions on the effectiveness of fairness in decision making in the process of water allocation and distribution and scheme type (Table 4). Fifty eights percent of the farmers in the semi-improved schemes showed strong adherence to the participation and fair say decision making design principle, while less farmers (32%) did so in the traditional FMISs.

However, reports from FG discussants in all cases illustrate that farmers are not satisfied with the representation. The water policy follows from the design principles and from institutional theory, implying that representatives in water user associations' committees were judicious in representing all resource users. For instance, in Mlenge schemes, there is an assumption that representative of the three leaders from each village to the Water User Association (WUA) is enough to give farmers' opinions. However, farmers reported that the approach is inadequate to represent their ideas and interests. On the basis of this finding, exclusion of local water users in resource management decisions is not only a constraint to equal access to water, but also to the term long endurance of water resources.

The importance of each smallholder farmer and wider social groups (such as women, the poor and youth) to participate in decision making as suggested by Sokile *et al.* (2005) will generate an effective institution to harness fairness and efficiency in water allocation and distribution. Cleaver (2002) reported that complete inclusion of youth in bureaucratic management structures responsible for creation of rules in-use caused challenges in implementation of collective arrangements. The findings correspond well with those of Kurian and Dietz (2005) study in Harayana-India and Fujile *et al.* (2005) in the Philippines who found that in irrigation schemes where a wide range of local water users are involved in creating operational rules, achieved both short and long term conducive impacts on water

management and resource conservation. The emphasis on fair say in decision making forums is paramount in the context of good governance of water especially under climate change and variability scenario.

4.2.4. Collective Choice Arrangements

Farmers' opinions regarding association between adherence to participation in collective action arrangements in facilitating water allocation and distribution and scheme type was significant (χ^2 = 10.462, p = 0. 005). Results further show that 83% of farmers in the traditional FMISs had strong adherence to this design principle while only 39% of the semi-improved FMISs has the same opinion (Table 4). This design principle has significant implications in the communal works such as participation in cleaning of the irrigation systems that facilitate water distribution in farmers' fields. According to Ostrom (1990) the principle also looks on how the people affected by the operational rules can participate in modifying the same. In view of this study finding, farmers in traditional schemes develop a wide range of rules to specify rights and responsibilities among themselves. They therefore cooperate more in collective works than those in semi-improved schemes. This may be explained by the fact that since the irrigation systems were poor in traditional schemes, farmers had many chances to meet, and interacted more hence the better ability to participate in modifying operational rules. A study based on game theories and experimental design argues that groups that interact repeatedly have higher cooperation rates (NRC, 2002). NRC's argument is shared by other researchers such as Shivakoti and Bastakoti *et al.* (2010) who argue that "in purely FMIS of Nepal users are involved from the very beginning and so they are bonded through collective efforts.

4.2.5. Monitoring System

The monitoring principle concerns actors who actively audit CPR conditions and appropriators' behaviour. The result showed no significant association (χ^2 = 1.14, p = 0.566) between people's perception on effectiveness of monitoring system and schemes type. Sixty nine percent of respondents in the traditional and 64% in the semi-improved irrigation schemes were satisfied with the performance of the monitoring systems. The findings were supported by information from irrigation association offices, which showed only five cases related to illegal water use in Mkula, three in Mlenge, while none in the traditional schemes at the time of the field survey. These findings suggest that monitors who actively audit water flowing in irrigation systems, as well as appropriators' behaviour were more accountable to the appropriators in the traditional than improved schemes. Generally, the high satisfaction level was attributed to the fact that monitoring was integral to the appropriators and not carried out as a separate activity. In periods of water shortage, every farmer and in particular water distributors were extremely accountable to ensure peoples' adherence to the operational rules. Frequent monitoring at the intake structures was essential to provide information on the condition of the intake and water flow. During FGDs, farmers reported that RRBWO was not adequate performing monitoring task as required. Farmers argued that RRBWOs officers were rarely appeared at water abstraction points hence illegal water abstraction existed. According to farmers, the officers frequently appeared at the end of cropping season, which is a period for revenue collection from water tax. Farmers further said that the catchment officers were always busy debating with TANESCO officers to restrict irrigators to use water for irrigation. Generally, we found that the basin offices had constraints such as inadequate staffing level and funds to enable offices to function efficiently. For example, in Kilombero sub- office, though the office had vehicles to discharge monitoring responsibility, they had no cash for fuel. A situation which is attributed by arbitrary ceiling imposed on the RBWO's budget proposals and marginal cost attached to water fees hence low net revenue. The failure of the RRBWOs to monitor water abstraction and even to motivate farmers on proper use of water contributed to mismanagement of water. This questions the viability of basin as it is one of the key features of IWRM.

4.2.6. Graduated Sanctions

Results on whether graduated sanctions are devised and applied consistently, and impersonally had no significant association with the two types of the schemes (χ^2 = 0.86, p = 0.65). Sanctions are mechanisms imposed to punish rule

violators or non-compliance with the collective rules. The findings revealed that majority (77%) of respondents trusted that sanctions were appropriately applied. According to Cleaver (2002) compliance with rules is usually sufficient to avoid incurring penalties. Franks and Cleaver (2007) reported that the exercise of punishing all misbehaviours against the common good is considered too costly in terms of time, effort, and social capital. In all cases, violation of rules attracts a variety of sanctions, although monetary fines and cash in kind were the most common. A fine system in terms of a live goat or cereals or even cash to defaulters is often seen as an important graduated sanction in Africa and elsewhere (Huang *et al.*, 2010; Patel *et al.*, 2014). In all cases sanctions were imposed by water user functionaries, village leaders or appropriators themselves. According to farmers, sanctions help to reduce the rate of which violation occurs, but it does not completely eliminate water management challenges.

4.2.7. Effectiveness of Conflict Resolution Mechanisms

This study inquired as to what extent farmers have a rapid access to low cost, swift or social networks to resolve water conflicts. Findings show that there was a significant association between traditional and semi improved scheme on the use of low cost mechanism in resolving water conflict disputes (χ^2= 6.105, p = 0.047). Fifty five percent of respondents in traditional FMISs were satisfied a rapid access to low cost social networks to resolve water conflicts, whereas only 36% in semi-improved FMISs were satisfied. This implies that local informal negotiations were often seen as an important and appropriate element to resolve disputes and more so in the traditional than the semi-improved schemes. This entails that the social capital is embedded more in the traditional than the improved schemes.

Discussants in the FGDs reported that conflict resolution was generally first solved by irrigators themselves or neighbourhood farm groups, through negotiations. Often elders or trusted persons within a farm or neighbourhood group were invited to be the conveyors in resolving the disputes. This provided a low cost arena for conflict resolution as it relied on already existing customary laws and village by-laws. Only if they could not reach consensus, they would refer to the irrigator association or village government or ward tribunal for further reconciliation.

In Iringa Rural District, the trust in disputes between agro-pastoralists and farmers at the village council is negligible due to the fact that corruption is very high. Farmers ascertain that when conflict arises between farmers and pastoralists, often pastoralists are the ones who would win the cases as they used their livestock wealth for bribing. The weakness of leaders to ensure that sanctions are followed and reconciliation in the case of disputes had negative influence on people's behaviour to adhere to operational rules. According to farmers, the most preferred means of conflict resolution was informal tier because there was hope for justice if corruption did not intervene. Elsewhere, the graduated sanctions tied with natural resources are more or less the same; for example Sokile and Van Koppen (2004) and Quinn *et al.* (2007) found that the formal system is expensive, time consuming and less trusted among local communities.

4.2.8. The Nested Enterprises

The nested enterprise design principle describes the multiple levels of institutional arrangements that are present in CPR regimes (Ostrom, 1990). There exists a direct interrelated responsibility of different actors and organizations on the process of water allocation and distribution (Table 4). However, there was no significant association (χ2 = 1.404, p = 0.496) between semi-improved and traditional schemes. In all cases there were mixtures of government (e.g. RRBWO, district council, village council, village environmental committee); NGOs (WWF, CARITAS – Faith Based Organisation) and informal social networks sharing the same water management objectives. Social farm groups were vibrant in collective works e.g. cleaning of tertiary canals, farm operations and water monitoring in their neighbourhood. The social networks were more visible in traditional than semi-improved FMISs.

Formal arrangements between two or more villages sharing an irrigation system were commonly existed in all schemes. For instance, Itunundu farmers with six other villages organized under an umbrella of Mlenge WUA shared the irrigation scheme. Each village provided members to committees at higher administrative levels, thus maintaining involvement for all water users within the catchment. However, the finding reveals weak horizontal linkages between

irrigator associations, livestock associations, wildlife associations, and the Pawaga prison in Iringa district. Above the village level, there are strong vertical linkages between RBWO, District Councils (DCs), irrigator associations and commercial farm actors. For example, the irrigators' associations were accountable to irrigators and DC.

5. CONCLUSIONS AND RECOMMENDATIONS

In our study, we attempted to assess existing institutional arrangements in the farmers managed irrigation schemes and evaluate performance of institutions governing water allocation and distribution in FMISs. Institutional landscape is rich in formal and informal rules and regulations, and that formal rules (IWRM features) alone are inadequate in governing the process of water allocation and distribution optimally and effectively.

The performance of the eight design principles (institutional indicators) in managing irrigation water yielded mixed results. At a generic level, farmers in the improved schemes seem to report better on clear boundaries, clear membership, congruence between appropriation and provision rules and local conditions and fair in representation in decision making processes. On the other side, farmers in the traditional schemes seem to have a better grip on monitoring and control, legitimate sanctions, collective actions and conflict resolution mechanisms that are swift and low-cost efficient. On the basis of findings, the indicators showed weaknesses and strengths of the formal institutions. They reflected the necessity of involving local water users in water decisions making and building on the existing informally established rules in order to come up with formal institutions that are swift and low cost efficient.

The study recommends that policy makers should recognize the role played by informal institutions and incorporate them to the principles of IWRM in order to emanate with robust and long enduring institutions. Likewise, decision makers and managers responsible in managing water and water resources should involve irrigators in decision making process. This will contribute most significantly to improve institutional performance, and thereby achieving sustainable use of water.

6. ACKNOWLEDGEMENT

This study was financed by SUA-Tanzania and NORAD-Norway Enhancing Pro-poor Innovations for Natural Resources and Agricultural Value Chains (EPINAV) program for which the authors are thankful. We acknowledge the anonymous reviewers whose useful comments and suggestions helped in improving the quality of this paper.

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