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Irrigation Management, Institutions and Local Livelihood Adaptation on Usangu Plains, Tanzania

By Sanket Patel, Paul Vedeld and Andrew Tarimo



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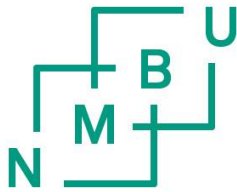
**Department of International Environment and Development Studies,
Noragric
Faculty of Social Sciences
Norwegian University of Life Sciences**

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¹ Dept. of International Environment and Development Studies/Noragric. Norwegian University of Life Sciences (NMBU).

² Dept. of International Environment and Development Studies/Noragric. Norwegian University of Life Sciences (NMBU).

³ Sokoine University of Agriculture, Morogoro, Tanzania.

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Irrigation Management, Institutions and Local Livelihood Adaptation on Usangu Plains, Tanzania

*Sanket Patel**, *Paul Vedeld** and *Andrew Tarimo***

Abstract

This paper studies the evolution of irrigation water management in Usangu Plains and evaluates present irrigation schemes using Ostrom's design principles for long-enduring common pool resources (CPR) and their influence on farmers' livelihood. Three types of schemes were identified for comparative analysis. These types include traditional, improved and formally improved irrigation schemes. The results of a survey and participatory assessments using both qualitative and quantitative approaches reveal that household incomes are heavily agricultural based (90% income share) and largely determined by the availability of water, land and the access to other farm inputs. There are differences in farmers' incomes in relation to schemes. We find that traditional scheme farmers are poorer. Improved management do depend on schemes' ability to organise, the willingness to change, and how institutions are crafted in relation to their needs. Households in the schemes with high level of accordance with Ostrom's design principles report better access to water and higher income security. Farmers' perceptions of new and more formalised institutions are positive, but in practice, many still rely on traditional ways of organisation and interaction. We do not see that there is a consistent contradiction between formal and informal, embedded social institutions, but we think that institutional transformation is better described as an evolutionary process of change where they co-exist, partly as complimentary or overlapping entities but also partly in conflict over certain issues. Public policies and formal and informal institutional frameworks have evolved over time in rather un-coordinated and often contradicting manners. In future policy-making, more attention should be put on developing a more coherent institutional architecture where room is made for both formal organisation and institutions while still utilizing and emphasising local and informal existing social institutional attitudes, values and norms.

Key Words: Irrigation management; Agriculture; Institutions; Livelihood analysis; Adaptation; Usangu plains.

* Department of Environment and Development Studies/Noragric, Norwegian University of Life Sciences, Box 5003, N-1432 Ås, Norway.** Sokoine University of Agriculture, Tanzania.

1. INTRODUCTION

Approximately 80% of the world's cultivated land is under rainfed agriculture supplying 60% of the world's food; while the remaining 20% under irrigation contributes 40% (FAO 2007). As water plays a vital role in rural development and enhanced livelihoods, there is a continuous development pressure to expand irrigated areas to increase production and decrease vulnerability of the poor households. Despite increases in water use by other sectors, irrigation still globally remains the main water user (UN 2009). A key challenge for a sustainable and efficient irrigation sector is to reduce water use while still increasing food production (IWMI 2008). Prudent planning, storage, allocation, reallocation framed under appropriate legislative and institutional frameworks, and sufficient capital for investment and maintenance are crucial factors for economic efficient and politically legitimate water management. At a global level, there is a policy discourse distinction between a neo-liberal approach heavily involving markets and payment for services approaches with an often individual focus versus a more public service and mixed economy approach where extension service and various types of cooperative and collaborative management schemes are more dominant and with more social focuses (source).

In Tanzania, development of water resources for irrigation has been a major thrust in increasing food production for a long time, but this has also increased conflicts over use of water resources (Franks et al. 2004). For decades, the World Bank, IMF, and various bilateral donors have continuously provided funds to support the government's efforts to alleviate poverty by targeting poor areas, poor groups and budgetary allocations for social programmes for vulnerable groups. Tanzania now pursues various bottom-up administrative reforms by building demand for change and capacity to implement development programs at local level. Today, the livelihoods of irrigators in southern Tanzania are under great pressure from many competing stakeholders, where the dynamics of water use are influenced by pastoralists, conservation policies, hydropower development schemes as well as local domestic water needs and local institutions and policies.

1.1 THE PRESENT SITUATION

Usangu is the central plain of Mkoji sub-catchment which lies in south-west Tanzania. Usangu Plains cover about 12% of the total Rufiji Basin, the largest river basin in Tanzania. It is one of the most important agricultural areas in the country. More than 80% of the people sustain their livelihoods from agriculture and livestock keeping by means of irrigated and rainfed water. The plains support about 30,000 rice-producing households who contribute some 14-30% of the national rice production (SMUWC 2001). The current dependence on rainfed agriculture and gravity fed irrigation limits agricultural development. Depending on the season, the irrigation coverage of the basin varies from 25,000-55,000 hectares, representing about 15% of total irrigation areas in Tanzania. During the dry season, the water supply does not meet the domestic, livestock, agriculture, wildlife and downstream hydro-power requirements (Franks et al. 2004).

Several interventions have been made to develop water resources in the Rufiji Basin, but despite this, improved irrigation schemes once again required rehabilitation efforts such as providing

technical and financial assistance in order to maintain physical structures of the schemes. Irrigators still face severe water shortages and conflicts over water access are common. The water policies were revised in 2002 with emphasis on equitable water supply, environmental sustainability, polluter pays principles, gender and cost recovery. However, the new participatory approach was still narrowly focused, and in many cases undermined the existing, more freely organised and locally adapted community water management activities (Sosovelo and Maganga 2005). Despite government's dependence on statutory schedules for water management, several studies have pointed to the existence of legal pluralism in present water resource management, which again is influenced by conflicting policies and goals (Cleaver 1999; Franks et al. 2004; Sosovelo et al. 2002).

1.2 PURPOSE

This paper studies the evolution of water management in Usangu. It compares three different types of schemes (traditional, modern, and improved with increasing levels of formalization, organisation and capital investments) in order to understand outcomes of development efforts and how water management has evolved over time. It also presents the current livelihood situation of farmers in relation to water management and analyses the impacts schemes seem to have and how farmers adapt to changes in the organisational structure and management of the schemes.

1.3 EVOLUTION OF WATER MANAGEMENT IN USANGU

1.3.1 Prior 19th century (Tribal Rule)

The recorded history of Usangu goes as far back as the establishment of the Wasangu tribe who dominated the political life on the plains through inter-tribal warfare (Pipping 1976). The area had abundant water, land, pastures, rich soils and wildlife (Charnley 1991). The Wasangu gave great respect to the water resources by regarding the wetlands of Usangu as their ritual places (Griffioen 2005). During this period, the traditional irrigation systems across the country varied depending on the physical condition of the area and the tribes themselves, but the use of irrigation was only for subsistence agriculture (Chiza 2005). Resources were managed under informal and customary rights which were most likely quite dynamic (Charnley 1991). Trade and migration influenced institutional changes, which at times came through peaceful negotiations, but also as the result of conflicts and warfare between various ethnic tribes (Charnley 1991). In Usangu, it was most likely the Arabs who first introduced a system of irrigated rice during the 18th century slave trade. Furrow irrigation was then practiced for irrigated rice by various tribes (Kissawike 2008). Several studies suggest that the Wasangu were mainly cattle breeders (Pipping 1976; Walsh 2007). However, farming of millet, sorghum, ground nuts, bean, peas, tobacco and irrigated maize were also practiced in southern Tanzania during this period (Kissawike 2008).

1.3.2 From 1884 to 1961 (Cost-Sharing – Colonial Rule)

The inter-tribal warfare and conflict over resources were completely suppressed after the invasion of Usangu by the Germans in 1890's (Charnley 1991). Hazlewood and Livingstone (1978) claim that irrigation systems during this period were developed through local ingenuity

without any specific institutional direction or management. While grazing rights were held in common by the village (Pipping 1976), non-irrigated land was typically privately owned by farmers who contributed in the construction and maintenance of the joint irrigation system. Irrigated land was also subject to redistribution by the village chief every year. By contrast, ownership of non-irrigated land was permanent and could also be inherited. Rice irrigation was re-introduced during the early 20th century when some in-migrants from Baluchistan (the Baluchi's) brought the skills and the crops. Many new irrigation networks were hand-dug to cultivate irrigated rice and maize, but it is believed that adoption of this innovation was quite slow (Pipping 1976). Livestock keeping still remained a major part of the economy, but with a high level of inequality in terms of cattle ownership (Fulleborn 1909 in Pipping 1976).

During the 1950s, many other tribes migrated to Usangu. Large numbers of livestock were driven into the wetlands and the pressures on the natural resources increased significantly (Griffioen 2005). Walsh (2007), however, disputes this claiming that the livestock presence in Usangu and seasonal transhumance in search of pastures did not create significant impact on the environment until the 1990's. Under the British colonial regime, the customary law to manage small-scale rural water use, which was under the authority of the tribal chiefs, retained their legal status. After 1955, several small construction works were carried out on the existing furrows (Kissawike 2008). The area was still dominated by the pastoralists during this period and the commercial rice production was low until the 1960's (Pipping 1976).

1.3.3 From 1961 to 1980s (Water for Free - Independence)

The most dramatic transformation came after independence when the new government abolished local taxes and also started supplying water as a free basic service in 1965 (Therkildsen 1986). Other important changes came with the unsuccessful and hard-handed Ujamaa Villagisation Programme which resulted in substantial land use changes, resettlement and redistribution of village land during the 1970's. Due to the high income potential of irrigating rice, of livestock-keeping and labour work on large state farms, in-migration in Usangu during this period resulted in a population increase of 50-60% (Fig. 1).

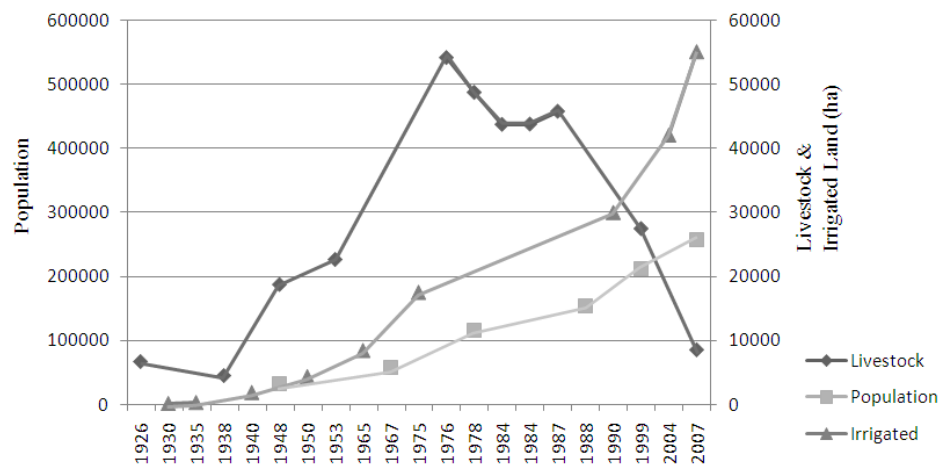


Fig. 1: Trends in human population, livestock and irrigated land in Usangu, Tanzania, 1926-2007
(Source: SMUWC 2001)

While in-migration of irrigators led to increases in land under irrigation, in-migration of pastoralists resulted in significant increases in total livestock numbers and total livestock population was at its peak in this period. These in-migrations increased tensions between irrigators and pastoralist over land and water resource use. Although formal water right regimes existed during this period, many farmers had no clear notion of property rights for water and there was virtually no control over water use (Pipping 1976; Hazlewood and Livingstone 1978). Despite substantial efforts, the government had failed to achieve the goal of providing all rural dwellers with adequate and easy access to water by 1991 (Maganga et al., 2002). In fact, partly due to a lack of consideration of property rights and ownership of these water schemes, many local communities perceived irrigation systems as the responsibility of the government (Therkildsen 1986; Maganga et al., 2002). Moreover, the local participation in planning and operation of schemes was hardly changed (even curbed in some cases), and no single rural interest group for water management emerged during the 1970s (Therkildsen 1986). Having the state responsible for the overall development and operation and maintenance of the water systems with no cost recovery or commitment from the users, and with a policy of “free water for all” approach proved to be a failure (Maganga et al. 2002).

1.3.4 1980s to 2007 (Present day IWRM)

The development of a new Water Policy in Tanzania began in 1986 and the re-introduction of water fees took place in 1994. As part of the structural adjustment policies of 1980s, the responsibility was devolved to village councils and Water User Associations (WUAs) to manage their small water supply and irrigation systems, whereas the management of larger systems still remained under central authorities (Maganga et al. 2002; Kissawike 2008). As a part of development initiatives various smallholder schemes were established in Usangu during the 1980s, which again led to in-migration and increased conflicts between irrigators and pastoralists. Even after the devolution and handover of irrigation schemes, farmers still relied on government to intervene and maintain or rehabilitate the infrastructure. Farmers had little concept of equitable water distribution and an operating schedule was difficult even after the training of scheme managers. On the other hand, the Baluchis and also other actors still successfully operated several large family owned rice farms, with their own furrows in Usangu (Kissawike 2008).

Research conducted during the 1990s found that the zero-flow in Ruaha River in the dry season is mainly caused by the water extraction for irrigation (SMUWC 2001). Despite this, according to Walsh (2007), the pastoralists on the plains were used as a scapegoat and evicted during 2007 under a governmental planned operation. The Rufiji Basin Water Office (RBWO) was established in 1993 with the primary goals of managing water allocation, pollution and protection, issuing abstractions rights, and collecting water fees in the basin (Maganga et al, 2002). Despite having formal water rights and regulation of water use for irrigation, downstream users are still deprived of water, especially during the dry season. Since 1994, several policies have been devised to address prevalent inefficient and conflict ridden water management practices by means of adopting an Integrated Water Resource Management (IWRM) approach. This relies on a statutory legal system, but due to the existing pluralistic legal system, both land and water resources are still regulated via a variety of legislations and various social institutions,

including statutory, customary, and even religious law (Sosovele and Maganga 2005, Cleaver 2002).

2. THEORY AND METHODS

2.1 LITERATURE REVIEW

Institutional arrangements include sets of rights that individuals hold, and provide basic informal or formal rules which govern specific activities of the resource management regimes among individuals and groups. Informal institutions are especially important for the analysis of common pool resources (CPRs) in developing countries because many resource use decisions are based on traditional local norms and rules, most of which are not integrated into nor displaced by formal laws (Bruns and Meinzen-Dick 1998; Quinn et al. 2007).

Concepts of institutions can be explored both through (competing) rationalist and social constructivist perspectives. A rationalist perspective implies that institutions are seen as consciously designed formal rules of procedure, conventions and protocol to serve particular interests. People are seen as being universally rational, with stable preferences and operating under a clear aims-means rationality. Organisations are formed and to serve the interests of the members and people participate or join because it serves their individual interests. Behaviour is seen as clear, rational and consistent. Rationality is universal. From a social constructivist perspective, on the other hand, institutions are understood as socially constructed values and norms forming frames of meaning. They are reproduced, transformed, and can even be undermined through dynamic processes of interactions and negotiations between or within communities and individuals (Cleaver 1999; Mehta et al. 1999). Preferences are not seen as stable or inert and are heavily shaped by existing institutions. Action is seen linked to social values and norms and appropriate contextualized behaviour. Institutions are overlapping and behaviour is contingent, reciprocal, negotiable and interpretative. Rationality is socially constructed; “in the eye of the actor” (Vedeld and Krogh, 2000, Cleaver 2002).

Common pool resources (CPRs) are often associated with scarcity or rivalry in consumption, lack of exclusion and accompanying over-exploitation. Often this relates to property right regimes of open access. Challenges of rivalry in consume and high costs of exclusion accentuates a discussion of tenure regimes that handle such issues. Classical tenure solutions for CPR problems include either centralised state control through regulations, or market driven approaches through private property rights (Hardin 1968; Olson 1971). Apart from an exception such as Taiwan's irrigation systems, where a top down approach apparently has been effective (Lam 1996), similar attempts in many developing countries have been unsustainable due to the management failure of government agencies (Vermillon 1999). Concerning common property regimes, some claim they are often inadequate for the management of CPRs as they are not able to tackle issues around exclusion costs, rivalry and also issues around free-riding, lack of ability to organise, in-efficient incentive structures etc.

Social constructivist institutional theory represents an alternative view to methodological individualism, where also individual rationalities are thought to be context dependent and

socially constructed (Vedeld and Krogh 2000; Vatn 2009). According to Ostrom (1990), who now claims to be less of a methodological individualist, decision-making should not be understood only based on profit or utility maximisation but rather in relation to institutions and social structures, such as reciprocity, reputation and trust. Resources can well be managed locally and a tragedy of commons (or open access) can be avoided if the right set of institutions are formulated and adhered to (Ostrom 1990; Cousins 2000). To analyse the institutional robustness of a common property regime, Ostrom (1990) originally provided eight design principles based on empirical analysis of many long-enduring CPR institutions. These principles can be used as an analytical framework.

Farmers' managed irrigation schemes (FMIS) fall under this category of CPRs, where boundaries are regulated through the irrigation infrastructure directly and irrigating outside the defined command area is considered as breach of the boundary. Rights and access to resource is usually defined through scheme membership or in relation to land holdings. Rules of water distribution, use, and operation and maintenance, which are established and agreed upon by all the farmers, reflect notion of duties and collective choice. CPRs are prone to conflict as are FMIS. Conflicts and violation of rules will in some cases lead to formalized, graduated sanctions. Cheap and more informal conflict resolution mechanisms are often facilitated by scheme management committee and village or local leaders. Under a devolutionary approach, irrigation schemes formulate their own institutions, which are not meant to be contested by external authority and thus recognises irrigator's rights to organise.

The process of self-governance and opportunities to craft locally adapted institutions is a powerful mechanism for utilising local knowledge and generating potential entrepreneurship at local levels. Through recursive observations, farmers can determine which rules and decisions lead to successful outcomes and, thus, by enabling them to organise and modify the rules contributes to crafting potentially robust institutions. This approach enhances the application of local knowledge, reduces cost of administration and monitoring, and increases the likelihood of agreement, which increases certainty and stability of the system. This implies that the success of resource management at local level eventually depends on a nested structure of institutional arrangements. Given that there are water catchment authorities overseeing water use at catchment level and distributing quotes for individual schemes and other water user interests, there will still be limits to what individual schemes are allowed to or able to do. Several studies of decentralised irrigation systems have drawn similar observations (Ostrom 1992; Tang 1992; Sarker and Itoh 2001).

Although Ostrom does not claim that design principles should be used as a blueprint, they have been directly translated into policy and criticised for not providing coherent theory to cope with the deeper social and culturally rooted processes of decision making and institutional analysis (Cleaver and Franks 2005). It is thought that formal institutions not built through "*institutional bricolage*" processes often carry a risk of eroding social capital (Cleaver 2002; Vedeld 2002). Moreover, participatory approaches have not always been successful and there has been a significant criticism in recent years (Cleaver 1999; Cooke and Kothari 2001; Vedeld 2002).

However, or even despite their critics, empirical evidence still suggest that adherence to the design principles in practice increases the probability of success for CPR management regimes (Quinn et al. 2006; Sarker and Itoh 2001).

From this, there are different underlying or ontological theoretical approaches at hand from which to analyze natural resource management (Table 1). One is a mainstream view of new institutional economics and property right theory which has been very influential on policy, whereas another "emerging view" refers to a diverse range of social constructivist perspectives, including insights from sociology, anthropology, political ecology and legal pluralism (Mehta et al. 2001 and Cleaver, 1999 and 2002).

Themes	Mainstream views	Emerging views
Livelihoods and natural resources management	Clear links between single resource and use	Multiple users, complex and diverse livelihood systems
Community	Local, specific user group, homogenous, bounded rationality	Multiple locations, diffuse, heterogeneous, diverse, multiple social identities
Institutions	Static, rules, managerial, functionalist, formal organizations and institutions emphasized	Institutions as socially constructed, embedded in practice, struggles over meaning, formal-informal, interlinked with knowledge and power
Property regimes	CPR as a set of rules based on collective action outcomes, clear universal boundaries;	Practice not rule determined, strategic, overlapping rights and responsibilities, ambiguity, inconsistency, flexibility, interpretation and negotiation
Resources	Material, economic, direct use-values, clear sets of interests	Also symbols, resources are locally and historically embedded and socially constructed, carriers of meaning and identity
Power and control	Transaction cost focus, elites, community leaders, common interests and perspectives	Differentiated actors, gender, conflict., bargaining, negotiation and power relations central

Sources; Partly from Mehta, Leach and Scones 2001, Cleaver 2007, and Vedeld 2002

Table 1: Mainstream and emerging approaches to natural resource management

Institutional perspectives suggests that marginalised agents (e.g., pastoralists) can successfully provide their livelihoods in semi-arid regions, provided that they have secure rights to land, access to markets, and opportunity to organise themselves and participate in decision making process (Vermillion 1999). More recent studies approach households from a livelihood perspective which presented household's ability to cope with vulnerabilities based on Sen's (1981), work on entitlements and more recent social constructivist perspectives which advocates in favour of actor-oriented, dynamic, participatory, multi-dimensional perspectives (De Haan 2005).

To address our research questions, we thus did employ the design principles to analyse the role of institutions in management and performance of irrigation schemes but with a careful eye for

its weaknesses. We somehow believe that their instrumental focus helped identifying crucial management challenges, and important issues of livelihood activities in relation to water availability.

2.2 STUDY AREA

Research was conducted on the Usangu Plains of Mbarali district in south-west Tanzania. Usangu is the central plain of Mkoji sub-catchment. Usangu is a rather flat area with an average elevation of 1100 m above sea level. It covers 20,811 km², which is about 12% of the total Rufiji Basin. The mean annual temperature varies from 18°C to 28°C depending on elevation. There is a single rainy season from November to April, amounts strongly correlated with altitude, ranging from 500 to 700 mm per annum. All rivers downstream are perceived as seasonal, mainly due to the dry season irrigated agriculture on the slopes that use all the water that would have kept the rivers flowing during the dry season. The rural economy is heavily based on smallholder agriculture and livestock production. Major crops produced during the wet season are rice and maize, while minor dry season crops include maize, beans, groundnuts, and vegetables (Kadigi et al. 2007).

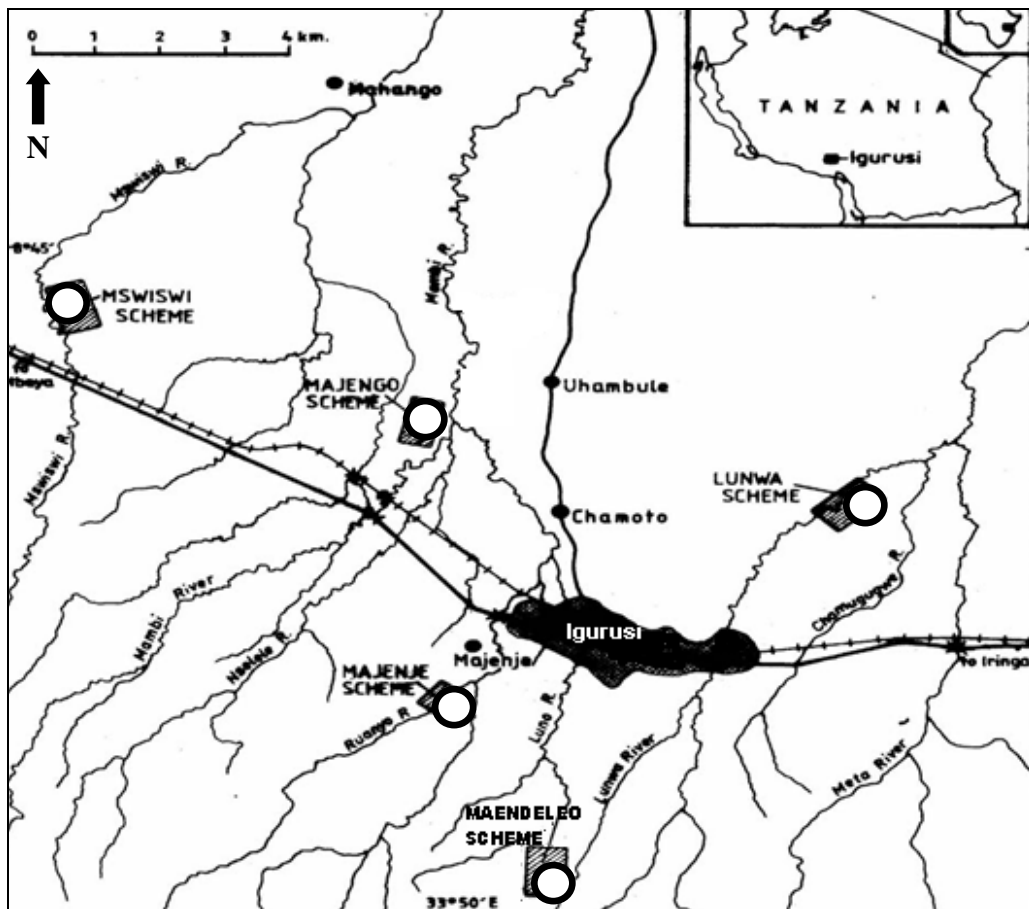


Fig. 2: Map of sample schemes and rivers (adopted from Mwakalila 2006).

2.3 METHODOLOGY

A mix of methods was employed to obtain both qualitative and quantitative information of water resource management in relation to the livelihood situation. A PRA methodology was adopted due to the amount of information needed to be gathered in a limited period of time. Household surveys were also conducted for more in-depth information and to validate and quantify the information obtained from the initial participatory assessments.

2.3.1. Data collection

The primary data collection methods included focus group discussions (FGDs), key informant interviews (KIIs) and household survey. A total of five irrigation schemes were selected: Lunwa Kilombero, Lunwa Mandendeleo, Rwanda - Majenje, Majengo and Mahango Mswiswi. A rationale for scheme selection was to cover all types of smallholder irrigation systems, which are located within a radius of 10 km near the Igurusi town (Fig. 2). These three types include *traditional systems* which use temporary diversion structure made of stones, logs and other local materials; *improved schemes* with concrete intake, but having traditional canals structures; and *formally improved schemes* with concrete intakes, sub-division structures, control devices and also a drainage system. The latter system also has a formal constitution and water rights allocated by RBWO and formal training of people.

FGDs preceded the rest of the data collection. In each scheme, an average of 25 to 30 farmers, both members and non-members were randomly selected for 3 separate FGDs. The household survey of 154 farmers was conducted using a structured questionnaire. A minimum of 10% of the sample from each scheme was achieved using a stratified random sampling method. Stratification was on basis of age, gender and duration of scheme farming. KIIs were in-depth and informal interviews of various stakeholders, driven by a set of questions, which also cross verified results of FGDs.

2.3.2. Data Analysis

The information gathered through various methods allowed us to create a matrix of indicators concerning various design principles in analysing institutions for resource management. These indicators were used to make both qualitative and quantitative assessments. A descriptive statistical analysis of the household survey was done using SPSS. An ordinary chi-square test was carried out to evaluate variations between the different groups of households. The total household incomes were divided in three categories: wet and dry season agriculture, livestock and others non-farms activities. Multiple linear regression analyses were also employed to investigate the relationship between income and household characteristics. Coefficients of variation and Gini coefficients were used to measure and assess various income sources and the levels of inequality. Further, a structural analysis was used to examine qualitative data collected from the PRA sessions and secondary data collection.

3. RESULTS AND DISCUSSION

3.1 INSTITUTIONS AND SCHEME MANAGEMENT

Analysis of the schemes using Ostrom's design principles provided insight into aspects of management and organisation in schemes and how well they function. The study finds that scheme management structures and content vary significantly between traditional and "improved" schemes (including formally improved schemes), mostly because once the schemes are established and "improved"; the scheme management receives training on operation and maintenance and also on how to govern schemes with increased farmers' participation. The traditional schemes often lack a written constitution, and management and strategies evolve less explicitly designed over time and interventions are implemented when deemed required. Unlike traditional schemes, both improved and formally improved schemes have clearer design and a more explicit devolved organisational structure, usually made up of a chairman, secretary, and committees for finance, security, welfare, and canal management. Although the main canal committee is the highest administrative body, it can only offer suggestions to the assembly. The assembly is guided by sub-canal committees representing all farmers. The scheme management is meant to formulate by-laws with farmers' participation. However, in most cases, these by-laws are either inherited or designed by the scheme developers e.g., government or donor agencies.

3.1.1 Rights and allocation

The external boundaries are clearly defined for all the schemes and controlled by RBWO through a single intake and explicit rules for water off-take. Internal boundaries are also clearly defined by means of the main, secondary and tertiary canals. Unlike the traditional schemes, limits in improved and formally improved schemes are formally imposed by means of constitution and schedules. However, the schedule is only enforced when water flow is low. Design of the schedule varies by scheme, which indicates an ability of schemes to plan and enforce a system of distribution to suit their specific location and needs. Farmers also get an opportunity to influence and design the water schedule, but very few interfere or are capable of exercising this right. Schedules are often worked out by scheme leaders with the help of the zonal irrigation office or an extension officer.

Farmers in *improved* and *formally improved* schemes perceive that an external boundary is more related to a formal and managerial institution that is the responsibility of an external authority such as RBWO to define and negotiate on their behalf. Cleaver and Franks (2005) argue in their study of Usangu, that defining clear boundaries is not easy, especially when the administrative boundaries are not in sync with physical resource boundaries. However, in dealing with internal scheme boundaries, the farmers in each canal are often directly involved and responsible for maintaining boundaries. According to the farmers, within the schemes there are few issues related to defining clear boundaries and almost 80% of the respondents perceive that rights in this way are clear and fairly defined. However, there are substantial concerns of breaking schedules (especially in traditional scheme) and often farmers near the intake draw more water than others. Only recently, some improved schemes have introduced a schedule starting from the tail-end and they have enforced a limitation on land each farmer may cultivate during the dry season in order to secure a fairer distribution.

The RBWO issues water rights to the schemes regardless of their status being formal or informal. Rights are issued on the basis of season and in exchange of annual water charges. These drawing rights are fixed to the schemes' land and they are neither transferable nor tradable; meaning that once issued they cannot be used for any purpose other than irrigation and cannot be transferred to other schemes. While all improved and formally improved schemes have formal water rights, many traditional schemes abstract water without any formal rights or without paying any fees, representing an example of legal pluralism. However, not allowing informal schemes to draw water would have a sudden and devastating effect on many farmers' livelihood. Thus, a more lenient approach allowing traditional schemes to gradually evolve from informal to more formal status and functioning may generate fewer conflicts. One could still secure a more consistent and sustainable water use than a strict formal enforcement enabled by the new bylaws.

Within the schemes, rights are formalised through membership, but all farmers cultivating land (including non-members) and paying fees are formally entitled to draw water. Members have the advantage of participation in scheme decision-making processes. Non-members often regard membership fees to be expensive, to be illegitimate and not worth paying for. Use of water in all the schemes for any other purpose, such as domestic, livestock, brick-laying or fishing is furthermore regarded as informal. Some 51% of the farmers claim that livestock creates severe damages to irrigation canals and they also lament that that pastoralists neither pay fees nor wish to participate in neither formal nor informal scheme management.

3.1.2 Duties and participation

At the time the payment system was introduced, no schemes paid the fees on time, which again led to canal closures, threats to production, and a strained relationship with RBWO. All the schemes (especially traditional) reported to have had their intake closed by RWBO at least once over last two years. Unlike traditional schemes, improved and formally improved schemes now regularly pay fees to RBWO. Depending on the management strength, currently about 70% to 90% of the farmers in improved and formally improved schemes pay fees regularly. An important remaining barrier in fee collection is a commonly view that water should remain free - as a gift from God- or the State. Furthermore, many farmers rent at least part of their land and tend to focus on short terms gains and rent payments. Also, almost 90% of the farmers hold plots in more than one scheme, and the commitment to several disparate responsibilities, such as cleaning and maintaining infrastructure in several places, having to pay more water charges, participate in more meetings etc. All these activities require more time, resources, labour use and management inputs, reducing willingness to pay the introduced fee. Apart from this, and as also discussed by other authors, many schemes are historically old, especially the traditional schemes and have an established and quite sustainable management practice needing and getting no input or support and see little reason or justification for any payment "that their ancestor have always seen as a right"(Maganga et al, 2002). In fact, most river basin authorities in Tanzania struggle in the sense that payments received are less than their management costs.

In most of the schemes, maintenance depends on labour provided by farmers. Thus, the quality of canals depend on how active and devoted various canal committees are. Canals are cleaned only once a year because most schemes do not have dry season water rights. Maintenance and repairs are only carried out when someone reports a problem. Once reported, they call a meeting and agree upon a course of action. This relates to how improved and formally improved schemes

were designed. Most farmers have a water depth of about 1 metre and a side slope length of about 3 metres. This makes it difficult to clean the canals with a mere hoe and a shovel. Many farmers (especially in traditional schemes) report to avoid participating in maintenance activities and only focus on maintaining their local and on-farm distribution structures. In schemes that span across several villages, the responsibilities of maintaining common structures are with the Ward Council. Along with access related conflicts, maintenance issues are also sources of conflict. Despite this, almost 60% of the respondents express that everyone in the scheme do perform their duties. To reduce such problems further, some of the improved schemes (Majenje and Mswiswi) have recently started to carry out maintenance by using hired labour and charging addition fees, instead of relying on involved farmers' labour.

Farmers complained that they are only well informed on matters related to fees and maintenance related activities, and quite ill-informed with regard to financial accounts. This is one major cause of farmers' reluctance to pay operation and maintenance fees. In some schemes, farmers contribute money for repairs when damage has occurred on a particular structure only. Along with poor organisation and irregular meetings, high opportunity and travelling costs are also important reasons for low levels of participation. Cleaver and Franks (2005) critically discuss this neo-institutional approach of "low cost decision-making" as the main reason for non-compliance. They involve a more general discussion of human agency: motivation and moral world views, complexities of individual identities and degree of social cohesion etc. (see also Cleaver, 2007). One aspect of this discussion is the high in-migration and ethnic diversity in Usanga. In our sample of 154 households for instance, we find that 62% have migrated in and there are more than 20 different ethnic groups, with an accompanying disparity in social status and roles reflected also in unequal power access and tension-ridden social relations, in many cases constraining both participation and collaboration efforts.

However, we do sense that in recent years one has seen improved participation efforts. In our survey, almost 77% of the farmers feel that they have a fairer and more equal opportunity to participate in the decision making process compared to before. Furthermore and unlike traditional schemes, most of the improved and formally improved schemes have at least two women appointed at the main and at sub-committee level. The Mahango Mswiswi scheme was primarily improved with aim of empowering women under the "Women in Irrigated Agriculture" programme. Today, women are more active and play major roles in running schemes. In other schemes, there tends to be a submissive exclusion of females and old people from participation in activities, which traditionally was regarded as male tasks as it was heavy manual work, and it also involved public speaking and training opportunities.

3.1.3 Monitoring, sanctions and conflict resolution

Monitoring task involves supervising water schedules and schemes infrastructure. Despite many dedicated committees, monitoring in most of the improved and formally improved schemes is still weak and like in the traditional schemes, they rely on farmers to look after their own canals. Water theft is reported in most of schemes. 42% of the respondents claim that people take more water than they are allowed, whereas others think that water distribution is quite fair and that the main problem remains water shortages (Table 2). Having plots in more than one scheme also becomes a serious problem here, as farmers are often absent from their secondary plots, giving free ride to the other cultivators. Lack of monitoring under such conditions provides opportunities for present farmers to misappropriate water. Only Mswiswi (improved scheme),

has two dedicated committees to carry out monitoring and have reportedly reduced violations and conflicts at the lower levels.

Table 2: Farmers' perceptions of institutions and management in irrigation schemes, Usangu, Tanzania, 2008

Institutions and management	Traditional	Improved	Formally improved	All	Overall adherence
Boundaries are clearly assigned?	61%	81%	80%	77 %	Yes
Rights are clear and fairly distributed?	72%	84%	72%	80 %	Yes
Should pastoralist be restricted?	66%	43%	56%	51%	No
Everyone carryout their duties?	47%	59%	75%	60 %	Yes
People take more 'water than allowed?	55%	38%	40%	42%	No
Water charges are paid regularly?	No	Yes	Yes	Yes	Yes
Fair say in decision making?	77%	74%	84%	77%	Yes
Do you often participate?	15%	74%	25%	53 %	No
Is monitoring system effective?	33%	43%	20%	36%	No
System of Sanctioning works well?	11%	42%	80%	44%	No
Conflicts over water use are common?	55%	43%	48%	46%	No
Internally conflicts are managed and resolved fairly	61%	84%	100%	82%	Yes
Conflicts with upstream/downstream users persist?	65%	54%	4%	46%	No

Within the schemes, violators are charged with penalties by the main committee. If the offender fails to reach or follow the agreement, the case can be referred to the village council and further to the ward executive council. In schemes with by-laws that have been approved by the District Council they can be taken further to a primary court. Still, water theft occurs frequently in traditional schemes, most likely because the sanctions are less strict. Traditional management tends to resolve issues through interpretative negotiations and compromises, whereas the village councils and courts mostly use formal penalties (see also Cleaver 2002). Under the traditional system penalties are not fixed and systems of law enforcement are rather loose and only 11% of these respondents claimed that the sanctions were working effectively. The reported sanction effectiveness were much higher in the improved (42%) and formally improved schemes (80%).

Cleaver and Franks (2005) on the other hand, argue that having a rigid and formal system of sanctions carry a large risk of eroding social trust, good mutual relationships and that it easily leads to more conflicts. However, we find that there are tough sanctions in Mswiswi (improved scheme), where village governments have appointed special “gate-raiders” who are the only ones allowed to operate schedules. Anyone found interfering is charged with a massive 200,000 fine. In this scheme, 75% still report that the system of sanctioning works well and that they think water is distributed fairly.

In terms of external conflicts, having rights enables the RBWO to protect the schemes’ allocation of water and impose sanctions on any encroachment. Sanctions and regulations related to

distribution of water among the schemes are also enforced for WUAs. WUAs play an important role in easing the communication among various schemes and resolving conflicts. They also call for regular meetings, help collecting fees and organising maintenance activities. Unlike the traditional scheme, most of the farmers in the improved and formally improved schemes are members of a WUA. Despite, apart from Mswiswi and Majenje, more than 50% of the farmers in other schemes claim that conflicts with upstream and downstream still persist and that negotiation in a WUA is difficult. Most of these improved schemes with conflicts have registered WUAs at their inception. However, with time they stop paying the annual subscription fees thus making them legally and practically non-functional.

3.1.4 Right to organise

RBWO is the external public body responsible for allocating water and charging fees to different users of the basin. Internally, all schemes have full rights to manage their allocated water resources without external interference. Almost 60% of the respondents claimed that local authorities have full control over their water resource and right to management the schemes. The ward executive council, zonal irrigation office, district office and village councils play important roles in water management but only in terms of aiding the irrigation development task, resolving conflicts and enforcing sanctions. Despite this, the farmers' perceptions about these authorities in most of the schemes are negative. Many farmers believe that authorities are not doing enough to help them maintaining the irrigation system. Such confusions are often a result of unclear communication, existing legal pluralism, and also a lack of knowledge about the formal institutions and organisational structures in which the water resource management functions.

3.1.5 Overall institutional adherence to the design principles

The design principles related to reasonably "clear" boundaries and distribution of rights were found present in all the schemes. The third principle of congruence between appropriation and provision rules is more or less absent in 3 (traditional and improved) out of the 5 schemes. Lack of capital and poor participation is often used as a scape goat by scheme managers, whereas poor leadership is often used as an argument by farmers for poor maintenance and management. In all schemes, farmers' opportunity to participate and influence decisions has significantly improved compared to the past. A major problem still remains in the sense that meetings are irregular and farmers' attendance are also irregular and low. The fifth principle related to effective monitoring procedures is only present in one improved scheme (Mswiswi). In all other schemes, monitoring is reported to be either weak or carried out on an ad hoc basis. Both the sixth and seventh principles related to sanctions and conflict resolutions were found present only in 2 schemes (improved and formally improved). In the other schemes, sanctions are also applied on an ad hoc basis and violators are not always caught or punished. Finally, the eighth design principle concerning the schemes' rights to organise and not be overruled from above are reportedly present in all schemes.

Table 2 summarizes some results of design principles by scheme type. Out of the 5 schemes, only Majenje (formally improved) is found to adhere to most of the design principles, and only Mswiswi (improved) seems to have a reported "good management" in place and seem to adhere to all the design principles. The improved scheme management quality depends on the ability to organise themselves and willingness to change, evolve and craft rules (such as using gate-raiders, imposing cultivation limits and charging maintenance fees) according to their needs rather than maintaining a traditional system of management. A majority of the farmers' perceptions of a new

formalised institutional way of management are basically positive, but in practice most of them still trust their traditional ways of organising and doing things. Such dynamics are better understood through the emerging views of institutions which observe them as “practices”. As an example, despite having mechanisms and opportunities, the participation levels are lower; despite having “clear boundaries” they still tend to overlap, most of them believe that they have fair and equal rights but still some access and use more water than others. This may reflect a contradiction between perception and practice, but could also be part of an evolutionary process where perceptions precede the changing of practises.

The differences between Cleaver/Franks findings and our findings are of combined theoretical and practical interest. Theoretically because we see Cleaver’s (2007) critique of Ostrom’s rather instrumental and rational choice oriented perspectives on social organisation as well-informed and well-formulated. She stresses the existence of local social values and norms both on environmental concerns and on social interactions, the implications of complex social actors with multilayered individual identities and motivations, the issues around social institutions, gender and issues around unequal interdependencies, structure and power. Further, embodiment and the physical capabilities of different actors and not least the importance of emotionality; where inter-relatedness, tolerance of ambiguity, community and relation feelings and embodied self-identities. Her argument on agency may lead to an emphasis on understanding the existing institutional landscape prior to interventions and that local response to policy must be interpreted through the existing institutions and processes of “institutional bricolage”.

Practically, the differences we observe between the traditional and the modern schemes are interesting because it in some ways may counteract Cleaver’s analysis. It becomes important how investments in the water sector are followed up with formal organisation, social organisation and training and the imposition of formal rules, still allowing for considerable local influence and local social institutional arrangements. We return to this.

3.2 LIVELIHOOD ADAPTATION AND IRRIGATION SCHEMES

The livelihood analysis assesses the use of water and irrigation as a means to improve livelihood outcomes and also provide insight into important economic constraints and coping strategies of the households.

3.2.1 Wealth groups, assets and incomes

Three wealth groups, “very poor”(less than TZS 1 mill.), “poor” (between TZS 1-2 mill.), and “less poor” (more than TZS 2 mill.), were identified based on average household income. The very poor households is represented by 53% of the total households, while the *poor* and *less poor* wealth group cover 25% and 22% respectively. Table 3 shows a series of chi-square and logistic regression analyses between the three wealth groups and various household economic characteristics.

The rice production depends on water as a major input and is the most important component of total household income. The total income is closely linked to the production of rice and increases steadily with the amount of area they cultivate. On average, all three groups report that 80% of their total household incomes are from agriculture, which is very high compared to other socio-economic investigations in Tanzania, reflecting the crucial role of irrigation in Usangu (Ellis 2000). Most of the land is inherited and held under a traditional rights system. Hiring land is common among the households (32%) in order to increase their water endowments. Only 15% of the households cultivate land through rain fed agriculture with no irrigation facilities. All groups (especially less poor) cultivate less land than their total land holdings, which means that some land may need fallowing or that either labour access or the amount of water available might not be sufficient or physically available for farmers to cultivate all their area every year. A total of 32% of the households claimed that the water stress level in agricultural production is highest among all alternative uses of water.

Household income increases with access to land, both owned and hired. The same applies for access to both family and hired labour and investments in other inputs. Socio-economic variables such as age of head of household, education and dependency ratio do not seem to have significant income effects.

Table 3: Wealth groups, household assets and income sources Usangu, Tanzania, 2008

Household variable	Very poor (n=83)	Poor (n=38)	Less poor (n=33)	Average (n=154)	Overall significance
Sex of hh (%female)	38.6 ^a	34.2 ^a	12.1 ^b	31.8	0.04 *
Household size (members)	5.6 ^a	6.5 ^{ab}	7.8 ^{ab}	6.3	0.00 *
Age (years)	46 ^a	44.2 ^{ab}	52.0 ^{ab}	46.8	0.05 *
Education Level	Junior Primary	Senior Primary	Senior Primary	-	0.13
Dependency ratio	0.51	0.57	0.59	0.54	0.17
Land holding (ha)	1.6 ^a	2.4 ^a	4.3 ^b	2.4	0.00 *
Land owned(ha)	1.3 ^a	1.3 ^a	2 ^b	1.5	0.02 *
Land cultivated (ha)	1.2 ^a	2.0 ^a	3 ^b	1.8	0.00 *
Dry season irrigation (ha)	0.15 ^a	0.52 ^b	0.7 ^b	0.4	0.00 *
Hired labour (TZS)	77 000 ^a	187 000 ^b	256 000 ^b	143 000	0.00*
Other farm input/transp. (TZS)	40 550 ^a	100 290 ^a	241 640 ^b	98380	0.02 *
Access to credit (1=yes 2=No)	1.8	1.7	1.8	1.8	0.71
Savings (TZS)	88 000	200 000	200 000	139 600	0.08
Yield of Rice (bags)	8.7 ^a	20.3 ^b	38.3 ^c	17.8	0.00 *
Income from livestock (TZS)	23 000 ^a	132 000 ^b	75 000 ^c	61 000	0.004 *
Income from off-farm, land rent, non-farm activities (TZS)	19 000 ^a	119 000 ^a	932 000 ^b	239 000	0.0045*
Income from agriculture (TZS)	442 000 ^a	1 184 300 ^b	4 058 400 ^c	1 400 000	0.001*
Total Income (TZS)	484 000 ^a	1 435 000 ^a	5 066 000 ^b	1 700 000	0.001 *

1 USD 1200 TZS.
 * indicates significant differences in the absolute incomes from a source between income groups ($p < 0.05$); income groups with different letter superscripts significantly differ in extent of dependence on a given source ($p < 0.05$) in a Tukey Kramer HSD test.

Very Poor Group This group report less assets than the other groups. Education levels are lower, they cultivate less land, especially during the dry season, and have less water access. The household have little capital and virtually no savings. Although the number of households having access to credit is similar to the other two groups, most of them are victims of an extremely expensive informal lending. Their average annual income is less than 0.5 mill. and more than 10 times lower than the less poor group. Their livestock endowments and income are also very low. They produce a small amount of rice and maize, they have lower yields per acreage, report to sell most of the rice (6.9. bags). They depend on family labour for production and use little hired labour and crop inputs compared to the other groups. The major source of cash income is irrigated rice. Very little is earned from other off-farm and non-farm labour activities.

Poor Group This group has somewhat more assets with education levels and a household size slightly higher than the “very poor” group. They also have larger areas under dry season irrigation, implying better water resource access than the “very poor” group. They report similar access to formal loans and claim to manage to save some money each year (0.2 mill.). These households cultivate almost twice the amount of land and use twice the amount of inputs and earn three times more (1.4 mill.) than the very poor group. Their incomes from other non-farm and off-farm activities are also higher (0.12 mill.). Their share of income from livestock keeping is significantly higher than both “very poor” and “less poor” groups (0.1mill.). This may be because the *very poor* are not able to acquire or keep livestock while the *less poor* groups are less livestock oriented and many also perceive of livestock as risky due to substantial and frequent losses and thefts reported in Usangu. *Very poor* are not able or cannot afford to take risks while the *less poor* can afford to avoid activities prone to risk.

Less Poor Group This group report higher asset access. Their family size and labour access is higher. They own and cultivate more land and the area used during the dry season is larger than for other two groups, also implying more water access. They cultivate three times more land (3 ha), use three times more hired labour (0.3 mill.) and four times the amount of other inputs (0.2 mill.) and they report much higher savings than “very poor” group. They report 10 times higher incomes (5.0 mill.) than the “*very poor*” group. Their income from other sources constitute a significant proportion of the total income. Most of this income is from non-farm activities such as business, rental and employment.

3.2.2 Livelihoods based on schemes

Obviously, livelihood outcomes do not only depend on water access, but also other production factor issues such as soil quality, location, credit and input/output market access, tenure, type of irrigation scheme, quality of management etc. contribute to livelihood outcome results. We find that households in traditional schemes cultivate more land and produce more rice than households in other scheme types. Still their income from agriculture is lower than others (Table 4). Farmers in the traditional schemes do usually not cultivate during the dry season due to lack of water access- and rights and they are less able to exploit the higher dry season crop prices. Moreover, their reported income from other sources is also low compared to the other groups (TZH 40 000).

Analysing the improved schemes we find that farmers in the schemes located on the high plains (such as Maendeleo) are better off because they have more access to water due the advantage of

the upstream, primary location. They are thus able to produce more crops during the dry season. Mswiswi scheme is located on middle plains and in dryer area, but farmers' income in this scheme are similar to those on higher plains. This is in part due to better scheme management and adherence to the institutions in Mswiswi. By contrast, farmers' incomes in Majengo scheme are somewhat lower (similar to those in traditional schemes) probably due to their reported weaker management and less adherence to the established formal institutions. The way Majengo was designed also made operation and maintenance difficult. Therefore, the option left was to run it as a traditional scheme.

Households in the formally improved scheme have more water available during the dry season and also better infrastructure facilities. Despite this, they produce less rice. Their incomes are slightly lower compared to the farmers in improved schemes. One of the reasons behind the low yield is that soil quality in this scheme is particularly low, and also because the reported adherence to the institutions in the scheme is weaker compared to the improved schemes. This implies that along with formalisation and improved infrastructure; also adherence to the management institutions and households' ability to diversify income sources is important to enhance household incomes.

Table 4: Income based on the type of scheme, Usangu, Tanzania, 2008.

	N	Land cultivated/hh (ha)	Bags of rice /ha	Agricultural income (TZS)	Other incomes (TZS)	Total income (TZS)
Traditional* (Kilombero)	18	2	10	1.16 m	0.04 m	1.20 m
Improved (total)	111	1.8	9	1.61 m	0.25 m	1.86 m
Majengo	43	1.7	10	1.11 m	0.13 m	1.24 m
Mswiswi	49	2	11	1.44 m	0.48 m	1.92 m
Maendeleo	19	1.7	5	2.29 m	0.15 m	2.44 m
Formally improved Ruanda/Majenje	25	1.5	9	1.31 m	0.16 m	1.47 m
Total sample average	154		9	1.4 m	0.3 m	1.7 m

3.2.3 Income distribution

The Gini coefficient shows that total income inequality among the households is rather high with a Gini coefficient of about 0.5 (Table 5). The agricultural incomes are as seen more evenly distributed than other sources of income, while other sources of income are more predominant among the less poor groups. The inequality in the traditional scheme is slightly lower than in improved schemes. The general income level is lower, and fewer households have access to dry season irrigation in the traditional schemes.

Table 5: Income distribution among the households, Usangu, Tanzania, 2008.

Scheme type	Agricultural and livestock income	Other income	Total income
Traditional Scheme	0.40	0.88	0.41
Improved Scheme	0.48	0.97	0.55
Formally Improved Scheme	0.55	0.90	0.56
Overall (n=154)	0.46	0.96	0.53

As these schemes' differences are trends in the material and not statistically significant findings we are careful to conclude. The differences, though small, may furthermore also be related to the location of the schemes as much as by the differential content or quality of scheme management reported by the villagers. It is still our impression as also reported by scheme members, that there are significant management differences in how schemes allocate water resources and in how this management is being perceived.

3.2.4 Adaptation and constraints

A multiple regression analysis of total household income by household assets shows that size of household, amount spent on agricultural inputs, amount of owned and cultivated land, and availability of water, all has positive and significant correlation to the total household income as expected (Table 6).

Major constraints are lack of access to technology such as power tiller and extension service, which can help farmers to enhance and increase income from agricultural and livestock production.

Cultivating less land in the dry season, using scheduled water supply, cultivating plots in more than one scheme, and attempts to diversify income by engaging in off-farm livelihood activities are important diversification strategies. Cultivating land in more than one scheme can provide income security, but may have negative consequences on both the total income and on the schemes, as farmers are often unable to provide competent attention to the various schemes they are part of.

Actors in existing schemes adapt to new institutions and organisations also in order to improve the productivity of water use. In the formally improved scheme (Majengo), it is stated through the constitution that any uncultivated land has to be sold after a certain period of time. This policy has been introduced to avoid having farmers who are not fully cultivating nor dedicating their time and effectively utilising their share of water for production. Given the deteriorating state of all the schemes, in general, it is clear that farmers are not only struggling to adapt to the technology of new improved irrigation system, but also to new water management institutions that came along with it. Thus, livelihoods, regardless of the season and coping strategies, are highly dependent on water availability and its management.

Table 6: Total household incomes and socio-economic characteristics, Usangu, Tanzania, 2008

Predictors	Coefficient	T	P
Constant	-	-1.52	0.134
Total household size	0.236	2.08	0.041*
Age of household head	0.060	0.71	0.476
Sex of household head	0,044	0.59	0,552
Education level household head	0.035	0.42	0,671
Dependency Ratio	-0.064	-0.65	0,514
Numbers of schemes involvement	-0.090	-1 18	0,241
Amount of land owned by the household	0.199	2.46	0,017*
Total amount of cultivated land	0,168	1.66	0,100
Costs of hired labour	0.004	0.04	0,966
Costs of fertilizer, pesticides and seeds	0.593	7.76	0.000*
Level of water availability and access during wet season	0,278	2.65	0,010*
Lack of water availability and access during dry season	-0.244	-2 29	0,025*
Amount of savings	0,120	1.26	0,210
Access to credit	0.131	1.68	0,097
* indicates significant effect of variable on income (p<0.05); R = 0.82 R-Sq = 0.67 F = 9.47 Sig. = 0.001			N = 154

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Usangu plains have experienced significant changes over time. The plains once dominated by cattle, are now dominated by rice fields. Ownership and management of water resources have switched back and forth between local and central governing bodies, with latest a seemingly devolutionary, IWRM based approach. Since independence, the human population has grown, the area under cultivation has increased and conflicts among various stakeholders have increased, whereas the quality of environment and natural resources such as wetlands and water are declining. While pastoralists have lost out, irrigators are at present the largest consumer of water. Moreover, policy and institutions of water management have evolved in un-coordinated and often contradicting manners. In these processes, the local social and often informal institutions which still largely prevail for managing local water resources have often been ignored by the policy makers.

Today, livelihoods remain very much dependent on agriculture and on water availability. Households in traditional schemes are slightly poorer than those in improved schemes. Overall, we also find it reported that households in the schemes with high level of adherence to the design principles report better access to water and to income security. Contrary to some other research, we also find that many farmers' perception of new formalised institutional ways of management are generally positive, but when it comes to obliging duties, most of them still trust their traditional ways of organising, reflecting the concerns of what we have called emerging views and what Cleaver (2002) sees as "institutional bricolage". Even if new bodies and institutions are attempted to be formally introduced, people will still use their institutional repertoire in their everyday struggle for survival and livelihoods and mould these structures together.

Another important cause for possible management failure is linked to prevailing popular local perceptions of improved irrigation systems as another principally public and free service like schools or roads. In addition comes the challenge of establishing water distribution mechanism and basin level taking where local communities are expected to take due consideration of both inter-sectorial distribution concerns as well as distribution concerns between different districts and communities concerning the irrigation water resources.

Ideals of establishing dynamic and flexible multi-level governance systems where more openness is contained for combining formal and informal institutions moulded in bricolage processes, as proposed by the emerging views, is definitely not an easy way to go in this context.

Legal systems, rights allocations and conflict resolution mechanisms are complex and will of course driven by different formal and informal system as pointed out in emerging views, and many results shows that irrigation schemes are more successful when management is local and competent. We do believe in combining formal and locally embedded institutions.

4.2 RECOMMENDATIONS

There is great potential to increase management and sustainability of irrigation schemes and enhance farmers' livelihoods in the study area. Since irrigation is the lifeline of the farmers in Usangu, an increase in incomes from rice and dry season production can significantly reduce poverty and increase the overall income equality among the different wealth groups in Usangu. In view of our findings, the following are the relevant recommendations:

- Land (and water access) consolidation across schemes can enable farmers to cultivate larger plots within one scheme and increase productivity of labour, water and scheme management in general, but only if issues such as poor soil fertility and water availability are addressed in the process.
- Policies which can deliver reliable and quality extension services in order to increase on-farm and off-farm water productivity, soil management (fertility) and also training farmers in raising livestock can make a huge difference to the overall household incomes.
- There is a special need for policies that can provide needs of downstream farmers and other stakeholders such as livestock-keeper and fishermen to access land and water. Thus, improvement of water management institutions and processes to harmonise formal and informal institution is very important, not least in this context.
- There is a significant potential for increasing the share of the total household incomes also from livestock and other economic activities.
- An intervention for future irrigation would be to have a smoother evolutionary process of scheme improvement strategies, where due emphasis is put on institutional bricolage

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