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**A Puzzle with Missing Pieces:
Institutional Analysis of Irrigation Schemes
in Iringa Rural District, Tanzania**

Master Thesis

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Declaration

I, Ronja Hüppe, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

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To the People of Itunundu & Mboliboli Villages

Abstract

Irrigation management has been internationally discussed and shapes national water policies, also in Tanzania. Yet, farmers in Iringa Rural district still suffer from too dry or flooded fields, while officials are blamed for failing to implement the water policy. Thus, to better understand what accounts for this gap between national regulations of irrigation and local irrigation practices, this study investigated the formalization process of the irrigation institutions from basin to village level and farmers' livelihoods and dependence on irrigation. Mixed methods were used; institutional characteristics of a traditional (TS) and semi-improved scheme (IS) were analysed and compared from a mainstream and critical institutionalist perspective, farmers' livelihoods with help of the sustainable livelihoods approach (SLA) (Ellis 2000a).

The findings suggest that communal irrigation management works; yet, the institutions resembled a bricolage rather than a fixed set of rules (Cleaver 2012; Ostrom 1990). The IS had a higher level of formalization than the TS, but water use-rules were informal and often unfair. The amount of allocated water and the area schemes serve is similar, yet, the IS is used by seven villages, while the TS only by two villages. SLA showed that farmers in the TS owned four times more land and had higher net-incomes than farmers in the IS. In both schemes, farmers highly depended on irrigation: 70% of their main income share came from irrigated paddies, yet, from input-extensive production. Thus, irrigated paddies have high investment potential; but high irrigation dependency and low crop diversity also comes with a high economic risk and may increase farmers' economic vulnerability. Further, a lack of water-allocation criteria on basin level facilitated the prioritization of hydropower over irrigation. Thus, farmers only have water access during the rainy season. Thus, formalization of schemes may lead to increased control over small-scale farmers and less resource access. Hence, farmers may face threat of resource appropriation by the state.

Thus, this study recommends further investigation of the basin-wide water re-allocation between different water sectors in general, and within the economic sector and between small-scale and large-scale users in particular. Moreover, Tanzania needs to define clearer criteria for and stricter monitoring of water allocation while leaving room for more community driven local irrigation management within schemes.

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Abbreviations

| | |
|-----------------|---|
| CI | Critical Institutionalism |
| DC | Iringa Rural District Council |
| FAO | Food and Agriculture Organization |
| EPINAV | Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains |
| HH | Household |
| IC | Village Irrigation Committee |
| IO | Irrigators' Organisation |
| MI | Mainstream Institutionalism |
| Mkombozi- TS | <i>Mkombozi</i> (swah.) traditional irrigation scheme |
| Mlenge-IS | <i>Mlenge</i> (swah.) semi-improved irrigation scheme |
| NAWAPO | National Water Policy |
| NGO | Non-Governmental Organizations |
| NMBU | Norges Miljø- og Biovitenskapelige Universitetet (Norwegian University of Life Sciences) |
| PES | Payments for Environmental Services |
| RBWO | Rufiji Basin Water Office |
| SUA | Sokoine University of Agriculture |
| TSh | Tanzanian Shilling |
| UN | United Nations |
| WAO | Ward Agricultural Officer |
| WTO | World Trade Organization |
| ZIU | Zonal Irrigation Unit |

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1 Introduction

Irrigation is nothing new. Its discovery dates back to pre-dynastic Egypt, where its earliest evidence was found on the mace-head of the Scorpion King around 3100 B.C. (Butzer 1976). Since then, irrigation has always been important as a technological tool to improve direct water supply and often being a deciding factor for success or failure of agricultural revolutions (Cleaver 1972; Watson 1974). However, with increasing water use and the development of environmental policies in the 1970s, irrigation remained not only a technological tool to improve water supply, but its management became a tool to govern water resources and its users, not always without problems. Thus, irrigation management has been internationally discussed and shapes national water policies since the earth summit in Rio de Janeiro in 1992 (UNCED 1992).

Tanzania's current water policy is no exception: it follows internationally adopted principles such as integrated water resource management (IWRM) and participatory approaches to involve farmers in irrigation management (WRM Act No 11 2009). So, Tanzania's water policy could be seen as a bridge to connect national regulations on irrigation with local irrigation practices. However, in the Southern Highlands of Tanzania where almost 90 percent of the rural farmers rely on small-scale irrigation agriculture (FAO, 2005), the bridge is seldom crossed. In the semi-arid area of Iringa Rural district, this leaves farmers to struggle with dried up or flooded fields, thus with lower agricultural yields and income. Officials, on the contrary, are blamed for failure of bureaucracy and implementation of the water policy. But why is the bridge seldom crossed, that is, what accounts for the gap between national regulations on irrigation and local irrigation practices?

In order to understand this gap, a mixed methods approach seems fitting. To get an objective overview on the importance of local irrigation practices, we quantified rules-in-use for managing irrigation and farmers' economic conditions. However, to get a holistic understanding, valuable explanations of actors' behaviour and the functioning and interlinking of institutions across levels are needed. Institutional analysis based on two theories, namely mainstream and critical institutionalism, offers these explanations. Hence, this study uses mixed methods with three objectives linked to three different levels: district, village, and household levels within the Rufiji River Basin.

In the Rufiji River Basin, several scholars have already explored causes of the gap between national regulations on irrigation and local irrigation practices, and how to close it. Namely Cleaver (2012), Franks and Cleaver (2007), Lankford et al. (2004), Maganga et al. (2004) have sought to understand how farmers' participate in resource management and how the water policy produces winners and losers (Cleaver 2012; Franks & Cleaver 2007; Lankford et al. 2004; Maganga et al. 2004). Meanwhile, Lankford, Kashaigili, Mahoo, and others have explored inter-sectoral water allocation and irrigation development in the wetlands of the basin (Kashaigili et al. 2003; Komakech et al. 2011; Lankford 2003; Lankford et al. 2004). However, the studies do not analyse how farmers' behaviour towards irrigation is linked to irrigation management on higher levels. Therefore, the first objective of the study focuses on how management of irrigation systems work across levels in a semi-arid area of Iringa Rural District, located in the Rufiji River basin, more specifically, in the Great Ruaha sub-basin (Franks & Cleaver 2007).

In the same River Basin, Sokile and van Koppen (2004) showed that farmers do not fully adopt formal institutions of the water policy. They still manage their irrigation schemes, but according to their informal institutions. The latter often seem to fit better the local conditions, such as varying river flow over the seasons, whereas formalized institutions, such as water rights, prove to be too rigid (Sokile & Van Koppen 2004). Cleaver adds to this, saying that local institutions often fit varying conditions better, because they serve multiple purposes. Thus, formal and single-purpose institutions can rarely replace them (Cleaver 2012). But one also has to ask why farmers do not fully adopt new institutions. Is it because new institutions are regulative and formal, and imposed by the state, or do the farmers lack incentives to adopt new institutions, that is, they do not see the benefits; or both? Therefore, the second objective seeks to give insight about how farmers, living in a semi-arid area, perceive and respond to formalization processes of their irrigation systems.

Moving from a social scientist to a natural scientist methodology, Kashaigili and Lankford have explored environmental flows in the catchment of Great Ruaha River. They analysed the impact of changing river flows on water uses, such as irrigation, based on hydrological data (Kashaigili et al. 2005; Kashaigili et al. 2007). Moreover, Kadigi and others discussed the value of water for competing water uses, irrigation and hydropower (Kadigi et al. 2008). Competition over water restricts farmers' agricultural production, thus reduce their income. Looking to the future, farmers are likely to compete over water for irrigation while river flows

remain difficult to predict and hence, leaving users uncertain about water availability. To see how dependent farmers are on the availability of water for irrigation, the study's third objective quantifies the economic impact of irrigation agriculture on farmers' income.

Moving on to the findings of this study: irrigation management starts with water-allocation for irrigation on basin level. The investigation of water allocation in the Great Ruaha basin revealed that the Rufiji Basin Water Office (RBWO) prioritizes hydropower over irrigation due to a lack of clear allocation-criteria. This leads to restrictions of farmers' water access for irrigation during the dry season and thus, to further economic and political marginalisation (section 5.1.1). Thus, formalization of schemes may lead to increased control over small-scale farmers and less resource access. Hence, farmers may face threats of resource appropriation by the state. Further, the investigation of the irrigation infrastructure in place displayed that farmers' economic marginalisation is reinforced by poor irrigation infrastructure. Thus, many farmers are still left with too little water or flooded farms (section 5.1.1). To complete the study's first objective, we identified the political actors who both define the irrigation regime and the processes of regime formalization and how they interlink. These are further discussed in section 5.1.2.

On local level, the investigation of the schemes' institutional characteristics showed that the semi-improved scheme has a higher level of formality than institutions of the traditional scheme as well as improved water use (section 5.2). Yet, irrigation regimes in both schemes emerged as a landscape of institutional bricolage, rather than as a clear set of consequential and mutually dependent rules. Thus, power relations and inequalities permeate both regimes and often lead to further exclusion of already poorer farmers. Further, in both schemes, water-use rules are merely informal as is monitoring and conflict solving.

On household (HH) level, we looked at HHs' resources, also called assets or capitals, and at livelihood strategies, also called activities (Ellis 2000a). HHs mostly draw on human, natural, and social capital, whereas they often lack physical and financial capital. SLA showed that farmers in the traditional scheme owned four times more land and had higher net-incomes than farmers in the semi-improved scheme. In both schemes, farmers highly depended on irrigation: 70% of their main income share came from irrigated paddies, yet, from input-extensive production. Thus, irrigation has high investment potential; yet, high irrigation dependency and low crop diversity also comes with a high economic risk and may increase

farmers' economic vulnerability. Hence, HHs have an overall agricultural livelihood strategy and they highly depend on irrigation (section 5.3).

Thus, this study recommends further investigation of the basin-wide water allocation between different water sectors in general, and within the economic sector and between small-scale and large-scale users in particular. Moreover, Tanzania needs to defining clearer criteria for and stricter monitoring of water allocation while leaving room for more community-driven local irrigation management within schemes.

1.1 Background

Irrigation and agricultural revolutions

As mentioned, irrigation is a tool for technological improvement of direct water supply. Already a few centuries after its first evidence in Egypt, irrigation was the main driver of the Arab Agricultural Revolution (700-1100 A.D.), allowing farmers to cultivate new introduced crops up to three times per year, that is moving from single to double or even triple cropping (Watson 1974).

Almost nine centuries after the Arab Agricultural Revolution, irrigation became again a main driver for another agricultural revolution. This time it was the 'Green revolution', which started in the 1950s in Mexico. Initiated and funded by North American foundations, scientists developed high yielding crop varieties to intensify agricultural production and tackle hunger in developing countries. But despite the genetic potential and the application of fertilizers, high yields could only be achieved with irrigation. Eventually, new irrigation technologies and subsidized inputs turned Mexico from a net importer of wheat to an exporter (Cleaver 1972). Due to the success, the green revolution was then transferred to Asian countries where so called modern rice varieties achieved high yields even faster than in Mexico (Cleaver 1972; Estudillo & Otsuka 2006). However, despite introducing and subsidizing high yielding crop varieties, fertilizer, and pesticides, irrigation remained the deciding factor for success or failure in many Asian and Latin-American countries (Cassman & Grassini 2013).

Whereas success dominates in these countries, the green revolution failed in almost all Africa (Bazuin et al. 2011; Cassman & Grassini 2013). Besides lacking irrigation technologies and

access to seeds, farmers resisted to adopt the new crop varieties because they did not fit the dryer climate of many Sub-Saharan countries and hence the needs of the farmers. Further, land is more abundant and farmers have thus less pressure to intensify production, inputs are expensive and output prices low (Bazuin et al. 2011). But hunger is still a problem. Thus, scientists try to replace the high yielding crop varieties with genetic modified varieties, initiating a ‘Gene Revolution’. However, all these revolutions to intensify agricultural production were not and will not be possible without irrigation development and, as SSA shows, without farmers implementing it. Therefore, irrigation and its management as a tool to improve direct water supply and to govern water resources and its users, both remain crucial: for the further agricultural development in general and for developing countries, such as Tanzania, in particular.

Tanzania’s water policies in a global context

Environmental politics in Tanzania has followed the international trend of integrating the environment into the economy, water becoming an economic good (Boelens & Vos 2012). Politicians started to slowly decentralize water policies and introduce economic instruments and IWRM as well. In 1981 the country was divided in nine river basins, each governed by a Basin Water Board, followed by compulsory registration of and payments for water use in the 1990s (Komakech et al. 2011).

Today, Tanzania’s water policy further decentralizes irrigation management through integrated water resource management (IWRM) and tries to involve farmers by organizing them in formalized entities, e.g. water user organizations (WUAs) (WRM Act No 11 2009). Through participating in WUAs, farmers are to be expected to protect their water resources and use them more sustainable (Komakech et al. 2011; WRM Act No 11 2009). This is well meant theory, but practice looks different.

Despite this participatory approach, the current water policy is based on statutory laws, ignoring the country’s pluralistic legal system which also recognizes customary and religious laws (Maganga et al. 2004). Thus, the state imposes new and formal institutions on irrigation schemes which conflicts with farmers, who still govern their irrigation schemes according to customary laws (Maganga et al. 2004; Sokile & Van Koppen 2004). In the Rufiji River Basin, this leaves a gap between national regulations on water and local irrigation practices; conflicts arise on local and regional levels among farmers (Patel et al. 2014) and sectors such as

irrigation and hydropower compete over water (Kashaigili et al. 2003; Komakech et al. 2011; Rajabu & Mahoo 2008; Van Koppen 2003).

1.2 Problem Statement

These problems are also present in the study area, Iringa Rural District. Here, competition over water use between the farmers and the hydropower dam downstream, limits paddy cultivation to once a year, whereas poor infrastructure and conflicts among farmers within irrigation schemes lead to unequal distribution of water. This leaves especially poorer farmers with less water or flooded fields, thus with lower yields and income. On the other hand, politicians are blamed for failing to implement the policy. In order to better understand where these problems stem from, the study examines first the functioning and interlinking of institutions around irrigation from basin to village level; second, the institutional characteristics of the irrigation schemes and the relations between farmers and irrigation institutions; and third the economic conditions of individual households. However, the specific objectives and research questions reflect thoughts derived from reviewing the literature and discussing two theoretical perspectives. Thus, they are presented at the end of the theory chapter (section 3.4).

1.3 Theory

The following section establishes the concept of water governance and introduces a framework for institutional analysis as well as the sustainable livelihoods approach. Within the framework for institutional analysis, institutions and actors' behaviour are discussed according to two schools of thought: mainstream institutionalism and critical institutionalism. The two schools have partly contradicting views on the role of the individual in society and on the development and characteristics of institutions, thus on the relationships between the two. Relationships between actors and institutions are the core of water governance, allowing us to understand how people manage their irrigation systems on the ground, and how the water policy is implemented. The sustainable livelihood approach is a concept and a framework to quantify livelihood conditions of farmers. It allows capturing farmers' monetary and non-monetary income sources while taking institutional arrangements into account.

Water Governance – a definition

Before moving on, it is important to understand precisely how the concept of water governance is used. Water governance is part of environmental governance and relates to both structures and processes of how to organize and access natural resources. Lemos and Agrawal (2006; p.2) refer to environmental governance as a “set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes”. Here, the authors picture political actors as the driving forces who rely on NGOs, communities and businesses to take action and forming political-economic relationships; the core of institutions in environmental governance (Lemos & Agrawal 2006). Similar to Lemos’ and Agrawal’s political-economic relationships, Rogers and Hall (2003) focus on official actors and governance as a way to produce certain outcomes. They define water governance as “the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society” (Rogers & Hall 2003; p.9). According to Franks and Cleaver (2007), the definition of Rogers and Hall (2003) is widely accepted and often linked to the concept of ‘integrated water resource management’ and ‘good governance’, implying that it leads to ‘good outcomes’ like the ‘delivery of water services’. Franks and Cleaver (2007) are further critical to ‘good outcomes’, and question for whom outcomes are beneficial. They “understand water governance as interlinked processes not as defined principles” (Franks & Cleaver 2007; abstract).

In one of their later works, Franks et al. (2013) suggest another definition which focuses more on structures and processes of how to organize and ensure water access rather than on water service delivery. They define water governance as “the systems of actors, resources, arrangements and processes which mediate access to water by citizens and other stakeholders” (Franks et al. 2013, p.4). This study will use this definition, but adding emphasize on mediating water access not only by different actors, but also on different government levels to cover more than the local perspective.

Analytical Framework and Institutional Theories

As mentioned, relationships between actors and institutions are the core of water governance. To ensure that all relationships are taken into consideration, a framework for studying environmental governance systems developed by Vatn (2011) and Vedeld and Kjosavik (2011) structures the analysis. The framework is based on theoretical assumptions derived

from theories on institutions and human action, namely mainstream and critical institutionalism. The following section briefly shows the different views of the two institutional theories on rational actions and the character of institutions.

Mainstream institutionalism bases its assumptions on a rational choice approach, where the individual's rationality is to maximize its own utility. The individual perceives institutions as external constraints and formal entities, such as 'the rules of the game', to facilitate social interaction, for example in communal irrigation management (Vatn 2005). Since institutions are perceived external to the individual, common characteristics of institutions can be identified. This is done by Ostrom (1990), who develops eight principles which characterise sustainable irrigation management. These principles were used in this study to get an overview about the state of the local irrigation schemes in the villages, and serve as a guide for the further theoretical discussion in chapter 3.

Critical institutionalists take on a socially constructed perspective. The individual influences society and is influenced by society itself. Hence, the individuals' rationality is not always self-maximization. It is rather bound to different kinds of social relationships and hence, the individual acts more social, that is, according to what it perceives as appropriate. Interactions in daily life as well as management of irrigation systems then rarely follow the 'rules of the game'. Rather socially constructed institutions guide peoples' interactions. Further, people's interactions and behaviours differ depending on the context and the role a person has in this context. For example, a person can be a strict leader at work and a tolerant and loving parent at home. Thus, institutions guiding human interactions resemble an institutional bricolage (Cleaver 2012). In this study, critical institutionalism helps to better understand social agency and issues of participation in communal irrigation management. In addition to the design principles, critical institutionalism lays the theoretical foundation for the second objective of this study and will further be discussed in chapter 3.

Sustainable Livelihood Approach

Sustainable livelihood approach (SLA) is both a concept and a framework to rural development (Vedeld 2013). SLA developed out of a critique of economic input-output models. It allows to study farmers' monetary and non-monetary resources while taking the political and institutional context into account (Ellis & Biggs 2001). SLA consists of three main characteristics: resources, so called assets, activities, and outcomes. Assets can be natural, human, financial, physical and social. The access to assets is determined by the

political and institutional context and depends on the vulnerability of a household. Further, assets determine the activities of a household. Activities can combine and substitute assets, diversify assets, distribute, and depend on assets and outcomes. Further, activities link assets and outcomes. Outcomes are positive or negative for the household and either accumulate capital over time and build assets or deplete assets of the household. Thus, outcomes directly determine the vulnerability of a household. That is, how people and institutions are able to buffer natural shocks such as hunger, drought, flood, pests, diseases, and civil war. In this study SLA will be used as a framework to quantify livelihood conditions and thus the vulnerability of farmers' households in Iringa Rural District.

1.4 Thesis Structure

Chapter 2 reviews literature on different approaches to water governance in general and in Tanzania in particular. It further draws attention to neglected areas such as institutions in an economical context, since water is considered an economic good (Boelens & Vos 2012), and the impact of institutional change on livelihoods. Both areas are relevant to understand the gap between national regulations on irrigation and local irrigation practices. To structure the analysis, chapter 3 explains the analytical framework for 'studying environmental governance systems' (Vedeld & Kjosavik 2011). It further gives an insight in the underlying theoretical assumptions, discussing mainstream and critical institutionalism as well as the sustainable livelihood approach in more detail. Chapter 4 presents the methodology and explains methods used for analysing the collected data and also describes details of the study area: location and climate, ethnicities, history of agriculture and irrigation, and current farming and irrigation practices. Chapter 5 displays and discusses the results of the analysis. Chapter 6 closes with conclusions and future recommendations.

2 Literature Review

This chapter gives an overview over existing literature on water governance related to the three objectives of the study. But Tanzania and its water policies do not stand alone; they stand in context with the general development of environmental policies. Therefore, the following section gives some background information on the development of environmental politics and governance.

According to Chasek et al. (2010), global environmental policies developed from the 1970s with the Montreal protocol as the first achievement of global environmental politics in 1987. Böcher (2012) and Gunningham (2009) described the early stages of environmental policies as characterized by strong state interventions through regulatory instruments, based on command and control principles. According to Komakech et al. (2011), this applied also to developing countries, although state regulations were often remaining structures from colonial times as in Tanzania, where water policies were centralized with all water belonging to the state and with water rights controlling its use.

In the 1980s, agricultural pollution came into the public focus and direct command and control principles was by many seen as too rigid to tackle these heterogeneous pollution sources (Gunningham 2009). Together with an ideological shift in politics and society towards neo-liberalism, this led to less state regulation; thus, voluntary and negotiated agreements increasingly became more frequent in order to regulate these heterogeneous pollution sources. But these voluntary agreements achieved mixed benefits for the environment (Gunningham 2009).

Bäckstrand (2010) describes the crisis of environmental governance since the 1980s similar to Gunningham (2009), but in more detail, referring to a trilemma of deficits. This trilemma consists of a governance deficit, that is, environmental problems are overlooked in politics because they are transnational and cross-sectoral; an implementation deficit due to the failure of translating rhetoric into practice; and a legitimacy deficit, because citizens lose confidence in the state management of the environment. Again similar to Gunningham (2009), Bäckstrand (2010) describes environmental governance as undergoing a 'deliberative turn' to strengthen democratic quality and performance, moving away from command and control to decentralized ways of steering. These ways include participation of public and private sectors

for legitimate and effective implementation, dialogue, transparency, and accountability (Bäckstrand 2010).

A result of the decentralizing development in the 1990s is the globally adopted principle of integrated water resource management (IWRM). Including four of the Dublin Principles (Swatuk 2005), it aims to promote “the coordinated development and management of water, land and related resources in order to maximise economic and social welfare without compromising the sustainability of ecosystems and the environment” (Global Water Partnership 2013; p.2). Ways to achieve coordinated development and management to maximise economic and social welfare are namely introducing new and formal institutions such as statutory laws and organise water users in formal entities such as water user associations (Swatuk 2005). Since economic and even more social welfare depends on ecosystems and the environment, the idea of IWRM is to integrate and account for sustainability of the environment besides other water uses. This means to ensure a certain amount of water flow in the rivers, called environmental flows, to keep the natural functions of the river as well as maintaining adjacent ecosystems. However, managing economic, social, and ecological uses of a river requires policies accounting for these complexities and implementation is hence challenging (Suhardiman & Giordano 2014).

Tanzania is no exception; integrating IWRM in Tanzania’s water policy causes issues of water re-allocation within a river basin, of changing and introducing new institutions and their nestedness across levels, as well as that the policies affect farmers’ livelihoods (Cleaver 1999; Dungumaro & Madulu 2003; Kashaigili et al. 2005; Lankford 2003; Lein & Tagseth 2009; Sokile et al. 2003). According to the three objectives of the study, the following sections aim to review the literature to put the mentioned issues in a broader context. Thus, related to the first objective of the study, the next section focuses on existing literature about water re-allocation and nestedness of institutions managing water use and distribution in Tanzania.

2.1 Water Re-Allocation and Institutions in River Basins (Obj.1)

Tanzania was divided into nine river basins as early as 1981, following hydrological boundaries in order to manage water resources in each basin. However, only a decade later when the first dams for hydropower generation were built, river basin management started and while it has been progressing since, it is still not fully implemented (Komakech et al.

2011). Hence, this leaves politicians and researchers with substantial challenges. Looking at literature on policies of river basins, researchers follow either a rational choice or a social constructivist approach. Social scientists tend to follow a social constructivist approach, investigating institutional designs, performance and outcomes. Natural scientists usually follow the rational choice approach and hence researchers focus on e.g. efficiency of water re-allocation, calculation of environmental flows of a river, and river basin development.

Keller et al. (1998) identified three stages of river basin development: an exploitation stage where people start to use water resources and where demand is satisfied, a conservation stage where water resources are fully developed, meaning that the basin reaches closure, and an augmentation stage where water needs to be transferred into the basin because water demand is bigger than its supply. When a basin reaches closure, inter-sectoral competition occurs and water needs to be efficiently re-allocated or saved. According to Keller et al. (1998), this is best done by measuring water savings using the concept of ‘effective efficiency’, which was developed and discussed by Keller and Keller (1995). Thus, Keller et al. (1998) view basin development as linear, following an economic and chronological rationality, arguing that one should always choose the cheapest solutions to overcome challenges when water resources of a basin become scarce (Molle 2003).

However, Molle (2003) and Kadigi et al. (2008) argue that basin development is more complex than Keller et al. (1998) suggest. In order to re-allocate water efficiently, state and farmers’ responses to inter-sectoral competition and different water sources need to be taken into account (Molle 2003). Basin development is influenced by power relations among different actors as well as by different water sources which are not equally available for water users. Thus, Molle (2003), showing that basin development is not always linear, moves away from a strictly economic rationality towards a political economic rationality, accounting for power relations and non-financial costs and benefits of water re-allocation. Following a similar approach, Kadigi et al. (2008) discuss efficiency of water re-allocation but with regard to value of water. In Tanzania, the economic value of water for hydropower is higher than for irrigation water. Hence, Kadigi et al. (2008) emphasize to distinguish between the highest economic returns – water for hydropower and industrial uses –, and the highest pro-poor returns – water for irrigation– when evaluating efficiency of water re-allocation.

Yet, Van Koppen and Tarimo (2014) look at the outcomes of water re-allocation for the poor in the Wami/Ruvu basin in Tanzania. They review IWRM since its introduction in the 1990s

and identify three challenges and setbacks for rural small-scale farmers. Firstly, externally financed basin studies focused on environmental issues rather than on involvement and improvement of small-scale farmers' livelihoods. Secondly, water permits were misused to prioritize commercial users, and thirdly, the introduction of new and formal institutions sidelines rural district and local government structures. Thus, Van Koppen and Tarimo (2014) recommend regulation of commercial users and development of water resources for all needs, free access to research findings, and empowerment of local authorities to improve monitoring and regulation of commercial users.

Although focussing on institutional arrangements between different actors of a river basin, Komakech et al. (2011) relate to Kadigi et al. (2008) and Molle (2003). They agree with Kadigi et al. (2008) by emphasizing Tanzania's dilemma between whether prioritizing local socio-economic development focusing on livelihoods and food security, or economic development of urban areas by using water for hydropower generation. When looking at the interface of local and state level institutional agreements in the Pangani River Basin, Komakech et al. (2011) take Molle's (2011) typology of responses further, introducing a meso-level to better understand institutional interplay. This meso-level constitutes in the dynamics between state and farmers' responses; that is, when the state introduces hydraulic infrastructure and hence creates or changes farmers' property rights. Herewith, Komakech et al. (2011) account for institutional interplays from state to local level when looking at re-allocation of water.

While describing how complex basin development and water re-allocation is, like Molle (2003), Kadigi et al. (2008), and Komakech et al. (2011), Kashaigili et al. (2003) focus on how to achieve efficient water re-allocation. In order to implement IWRM, they review literature on inter-sectoral water allocation in Tanzania, assessing constraints and potentials of different water uses and users within a river basin. Later, Kashaigili et al. (2005) investigate how to re-allocate water for the environment within the Great Ruaha river basin, Tanzania, based on historical water flow records. They assess challenges and options to ensure environmental flows in the rivers. Kashaigili et al. (2007) then conduct a hydrological study based on monthly water flows, estimating environmental flow requirements to avoid drying up of the Great Ruaha river. Thus, taking a hydrological approach to water re-allocation, Kashaigili et al. (2007) stress the need to ensure environmental flows by increasing efficiency of other water uses, but do not take irrigation-governing institutions into account.

Therefore, it is worth taking a closer look at Lankford (2004; 2012) where he focuses on different approaches to irrigation planning and performance within a river basin. Lankford (2004) discusses an agronomic approach to irrigation planning in relation to farmers' livelihoods, whereas Lankford (2012) discusses two paradigms of irrigation efficiency. Lankford (2004) argues that the widely used crop water requirement (CWR) approach is inappropriate for irrigation planning; because CWR aims to ensure maximum yields for an area served by a single irrigation system, ignoring other water needs in the river basin. Therefore, he suggests taking a protective approach to irrigation planning. This means to ensure minimum yields over a maximum area to minimize the risk for widespread famine and ensure equal water access for a higher number of farmers. Thus, Lankford (2004) touches upon Kadigi et al.'s (2008) argument that when evaluating efficiency of water re-allocation one has to distinguish between the highest pro-poor returns and the highest economic returns. Yet, Lankford (2004) takes a pro-poor stand at the outset of his study.

In his work, Lankford (2012) deconstructs two paradigms of irrigation efficiency showing their different values as complex but useful measures of irrigation performance. The first paradigm draws on Keller and Keller's 'effective irrigation efficiency'. Here, irrigation systems are pictured as closed entities, following the logic of mass continuity where input and output flows mutually affect and balance each other. However, Lankford (2012) argues that effective efficiency has its value in basin modelling and holds only in practice for block-type systems such as centre-pivot irrigation systems. But applied to river basins, Lankford challenges this approach by viewing river basins as disaggregated into basin, system, and intra-system level, or a mosaic of block-type systems. Thus, losses in one irrigation system negatively influence water availability for other water users and the logic of mass continuity does not hold any longer. Then, the second paradigm, drawing on classical irrigation efficiency, keeps its merits for designing, controlling, and equitably managing irrigation across different levels. Finally, water demand and supply within and between different levels of irrigation systems is constantly moving and makes matching demand and supply in one unit complicated and hence prone to mismatch. Herewith, Lankford (2012) shows the difficulty of measuring efficiency of a moving resource and hence the challenge to distribute it equally in the river basin. Thus, he concludes that strengthening irrigation performance should start with farmers' competition issues. However, to improve water re-allocation and irrigation development he stresses the need for long-term research and interdisciplinary approaches.

Here it is worth mentioning Rajabu (2007), who investigates problems of water re-allocation using a bottom-up approach. Instead of looking from the top on how to measure irrigation efficiency like Lankford (2012), Rajabu (2007) lets water users participate in a so called river basin game. In three workshops water users learn to understand and formulate their own problems, practices and solutions to competition over water. Rajabu (2007) views this approach as a valuable tool to trigger discussions and behavioural change to achieve more equal water distribution. With that he accounts for institutional interplay but only on a local and sector-internal level.

Summing up, with their three stages of basin development Keller et al. (1998) created a framework for water re-allocation but only focussing on economic efficiency of re-allocation. Molle (2003) develops this framework further, adding a typology of actors' responses to basin closure, but excluding the dynamics of institutional arrangements. Komakech et al. (2011) and Rajabu (2007) finally account for institutional interplays. But Komakech et al. (2011) focus on the areas in the basin where water is reasonably abundant, whereas Rajabu (2007) focuses only on interplays at the local community level. Meanwhile, Kashaigili et al. (2003; 2005; 2007) investigate environmental flow requirements, giving useful insight from a hydrological perspective. But they do not take different actors and institutions into account which also influence environmental flows in a river basin. Similarly, Lankford (2004; 2012) deconstructs different measurements for irrigation performance. Although sub-dividing irrigation systems into different levels with different actors, Lankford does not account for institutional interplays across these levels.

Komakech et al. (2011) come closest to investigating institutional and actor-institutional interplays in a river basin across levels. Nevertheless, they neglect the impact of semi-arid areas on institutional arrangements for irrigation, which is therefore the focus of the study's first objective.

Following the second objective, we move from focussing on institutional interplay across levels to institutional analysis on local level. Thus, the next section gives an overview over literature on relationships between farmers and institutions around irrigation in Tanzania.

2.2 Relations Between Farmers and Institutions (Obj. 2)

Although differing in approaches, all cited authors discuss the implementation of IWRM, analysing human behaviour and institutions involved. According to Cleaver (2012), there are two different schools of thought on analysing institutions of natural resource management: mainstream institutionalism (MI) and critical institutionalism (CI). Hall et al. (2014), drawing on Johnson (2004), discuss the differences between MI and CI. MI uses ideas of new institutional economics and describes what is commonly known as collective action or common property scholarship, hence, complying with rational choice and functional assumptions. In contrast, CI sees human action following a social rationality, thus questioning the rational choice and functional assumptions of MI. More specifically, CI questions assumptions about the homogeneity of local communities and thus excluding communal politics from the analysis, the simplification of the institutional analysis by neglecting the power of local authorities, and social values and norms. However, CI is not always opposing MI since views and objectives overlap in some cases, but they rather question a universal theory for managing common goods and explaining individual and collective behaviour (Hall et al. 2014). Here, one has to recognize that MI and CI have incompatible underlying rationalities. An individual cannot maximise its own utility while at the same time acting according to what is socially appropriate. Yet, MI's and CI's insights on institutional characteristics, for example, are commensurable. MI's claim that resource boundaries should be clearly defined does not contradict CI's claim that resource boundaries are dynamic and thus, need to change between seasons (Cleaver & Franks 2005; Ostrom 1990). Using both insights, one could rather draw the conclusion that resource boundaries and access-rules should be clearly defined for each season in order to ensure long-enduring institutions.

However, since this study analyses the relationships between farmers and institutions from a MI and CI point of view, the following section follows this distinction as well. Starting with the MI school of thought, Elinor Ostrom's works are major contributions to studying collective action in common-pool resources, such as water for irrigation agriculture. In Ostrom (1990), she defines her design principles, challenging Hardin's 'tragedy of the commons' (Hardin 1968). The design principles are common institutional characteristics of a large number of case studies, where communities managed their common resources sustainably and successfully. Since they are a valuable tool in the field to check for

institutional characteristics, they were used in this study to investigate institutions around irrigation systems in the villages.

Besides institutions, social norms influence peoples' motives and behaviour and thus, Ostrom (2000) discusses communities' actions in relation to social norms, challenging the assumption of actors being merely 'rational egoists'. To investigate collective action, for example why some people in a community cooperate and some not, she sets up game theoretical experiments using evolutionary theory to explain her findings. After conducting lab experiments, she revises the theory about collective action acknowledging the existence of norm-driven types of actors. In the next step, based on the assumption that humans inherit the ability to adapt to social norms, she uses an indirect evolutionary approach to discuss preferences, also related to norms, and how they evolve and adapt. In this approach, people may behave differently in the same situation, because they follow different preferences and social norms. Thus, people are relational, influencing and learning from each other, possibly changing their preferences and behaviour.

When applying the lab findings to the field, people seem to successfully manage resources because social norms, mutual trust, and some norm-driven actors exist who are willing to cooperate as well as punish free-riders. However, the overriding fact why some communities successfully manage their resources seems to be possible to explain by investigating certain design principles. Evolutionary theory then helps to explain their functioning as well as identifying contextual variables which threaten the functioning. Concluding, Ostrom (2000) views evolutionary theory as the first step to create a general theoretical synthesis of how context affects the presence or absence of norm-driven actors and thus, the adoption of their norms to enable and strengthen collective action.

Herewith, she acknowledges – at least to a certain extent – that communities are heterogenic, norm-driven and that context matters. Nevertheless, she aims to reveal the existence of common, cross-community types of actors and institutional characteristics in order to generally investigate human action.

However, the heterogeneity of communities not only applies to their actors, but also to their institutions. Therefore, Ostrom (2005) discusses challenges of human interaction, namely the diversity of institutions and the diversity of physical and cultural settings in which humans interact. Remaining true to her commitment of revealing common characteristics of human

interaction (Ostrom 2000), she looks for common underlying ‘building blocks’ which structure institutions and interactions across societies. Moreover, she argues that a scientific explanation just needs enough variables to explain, understand and predict outcomes and empirical support of these predictions (Ostrom 2005, pp.7-8). Hence, she regards it possible to simplify and generally assess human interaction with a framework. She suggests the Institutional Analysis and Development (IAD) framework to see how institutions as well as various external variables affect human behaviour in a community.

According to Ostrom (2005), one important variable of this framework is institutions as the rules which govern human interactions. They can be written formal laws or rights to certain properties, unwritten norms of how to behave in a specific situation, or strategies of individual actions. To understand processes of governance, one needs to understand where rules originate and to which rules people refer to justify their actions. Rules originate from formal legal procedures, self-conscious crafting by individuals, or as a result of problem-solving interactions. Thus, people are mostly aware of these rules and can consciously choose whether to follow them. However, people have complex cognitive systems guiding their behaviour. Thus, they are not always conscious about every rule they follow which makes it sometimes difficult to identify the rules-in-use.

This also influences the predictability and stability of rules. Since rules are formulated in human language, they may lack clarity, be changed, or misunderstood and hence, difficult to predict. The stability of rules depends on whether people share the same meaning and understanding of the actions which the rules determine, and on their enforcement. If people can easily break the rules, the stability will decrease over time. Thus, monitoring and sanctioning – two important characteristics of the design principles – become important. However, Ostrom (2005) argues that people are not only following rules if sanctioned otherwise, because costs of enforcement would be too high. Thus people must commonly perceive certain rules as appropriate when interacting in a certain situation, such as norm-driven actors who decide to cooperate when managing their water resources (Ostrom 2000).

Summing up, Ostrom (1990; 2000; 2005) aims to reveal common characteristics of human interaction in natural resource management. Therefore, she draws on evolutionary theory and game theoretical approaches to explain human interaction. The presence of cooperative actors and institutions, such as the rules-in-use, are important characteristics for communal resource management, whereas the diversity of local institutions and physical and cultural settings are

major challenges. This implies also that the design principles should not be seen as blueprints for investigating collective action. Hence, in this study they are used as relevant structural and explanatory tools, especially to investigate how people manage their irrigation schemes in the field. Yet, Wilson et al. (2013) value the design principles because of their theoretical generality and the possibility to apply them to different contexts. This is also done by other researchers (Cinner et al. 2012; Huntjens et al. 2012; Quinn et al. 2007; Sarker & Itoh 2001) as well as by politicians to structure country politics, such as Tanzania's water policy (Cleaver & Franks 2005; NAWAPO 2002).

However, what are considered strengths for some are weaknesses for others. Indeed, Ostrom is critiqued for the theoretical generality and thus simplification of human interaction, ignoring social and historical contexts (Cleaver 1999; 2001; Cleaver & Franks 2005; 2007; 2012; Franks & Cleaver 2007; Hall et al. 2014). Nonetheless, critical institutionalist scholars recognize the contribution of mainstream institutionalists to show the potential of community based natural resource management and the practical appeal of the design principles. They criticize researchers and politicians for using the design principles as blueprints, not doing justice to Ostrom's nuanced work. Cleaver (2001); (2012) and Cleaver and Franks (2005) show high recognition for Ostrom's nuanced descriptions of institutions characterizing successful communal resource management.

Thus, critical institutionalist scholars both expand and challenge Ostrom's work. Cleaver (2001) for example expands the design principles by introducing the concept of institutional bricolage. Here, she views institutions for collective action not only as robust structures crafted for a certain purpose, but also as dynamic, albeit temporary, influenced by everyday actions. Cleaver (2012) challenges the design principles when focussing on social justice in communal resource management. She argues that institutions characterized by the design principles, although sustainable, do not ensure equal access and distribution of water resources. Thus, one needs to go further and understand how institutions work and why they benefit only some people.

However, the main critiques to Ostrom's work remain: the functionalist assumptions underlying institutional thinking, equating long enduring institutions with formal structure, and over-simplifying social aspects. These assumptions then allow using the design principles as blueprints to structure policies, as is the case in Tanzania (Cleaver & Franks 2005; Hall et al. 2014; NAWAPO 2002). Thus, much of the critique of MI relates to the implementation of

Tanzania's water policy: namely the introduction of formal institutions, as well as nature and outcomes of participatory approaches. The latter also discusses power relations in communal water management, which adds to the foundation of the study's second objective: aiming to analyse relations between farmers their institutions related to irrigation management.

Tanzania's water policy is the construct of irrigation management and its formal structure often overrides informal and customary institutions. Van Koppen (2003), Maganga et al. (2004), Sokile and Van Koppen (2004), and Rajabu and Mahoo (2008) all challenge formal water rights of Tanzania's water policy. Van Koppen (2003), Maganga et al. (2004), Sokile et al. (2003), and Sokile and Van Koppen (2004) argue that formal water rights override customary water rights although Tanzania operates under a plural legal system. Specifically, Van Koppen (2003) argues that the main challenge is not absolute water scarcity but scarcity of economic resources to access and distribute water. She concludes, to make water available to farmers the government should subsidize small-scale farmers rather than charge water use fees.

Meanwhile, Sokile et al. (2003) and Sokile and Van Koppen (2004), drawing on findings from the Rufiji River Basin, argue that against claims of being ineffective, informal institutions actually work effectively for managing irrigation. This is for two reasons: the majority of farmers prefer to use their local informal institutions to solve conflicts, and, although much effort has been done to implement formal water rights, farmers affiliate with their local institutions and do not use the formal ones. Thus, the authors suggest that in order to improve irrigation management, the government should learn from and recognize local informal institutions rather than overlook them. Maganga et al. (2004) not only argue that formal institutions override farmers' local institutions; formal institutions also negatively affect farmers by destroying their customary systems.

Rajabu and Mahoo (2008) do not directly criticise the nature of formal institutions, but discuss problems of water use that occur when farmers get formal water rights. According to the government's rationality, water rights should control and increase efficiency of water use by granting farmers a certain amount of water and making them pay for it. But the authors found out that water rights not always lead to more efficient water use. In contrast, since farmers pay for their water right, they tend to extract all water granted, which is often more than their crops need. Thus, formal water rights, supposed to increase efficiency of water use,

also have unintended consequences and lead to contradictory behaviour when put into practice.

Similar contradictions occur when looking at the nature and outcomes of participatory approaches used to implement formal water rights. According to the policy, farmers participate by contributing money, labour, or time for improving and managing irrigation schemes (NAWAPO 2002). The Tanzanian government, development agencies, and researchers, such as Dungumaro and Madulu (2003), conclude that this kind of participation is a means to development, ensuring democracy, acceptability and sustainability of water projects (Cleaver 1999; Dungumaro & Madulu 2003). In contrast, Cleaver (1999); (2007) challenges these assumptions, arguing that there is no evidence that participatory approaches improve livelihood conditions of and empower the most marginalized people in the long term. The participatory approach rather has become “a faith” or a general strategy to development that goes unquestioned.

Thus, Cleaver (1999) critically reflects on the participatory approach in development discourses. More specifically, she questions governments and development agencies’ assumptions of participation as increasing efficiency of water management, effectiveness of investment in irrigation schemes, and contribution to democratization and empowerment. She argues that participatory approaches to empower local farmers rather remain rhetoric, adding moral values to the project. And if not, development agencies remain unclear of who is empowered and how. Thus, Cleaver (1999) suggests that development agencies should not assume participation per se as benefitting to farmers, but rather take issues of social power relations into account. But therefore, one needs to examine underlying concepts and the diversity of patterns of interaction between individuals and social structures. However, she argues that these patterns seem to be too complex to be recognized by development agencies, which are often influenced by rational choice and functional assumptions. Hence, they rather follow the government approach and focus on organizing community based resource management; that is, support of formalizing and introducing new institutions to irrigation management.

Cleaver (1999) views these formal and functional institutions as too rigid, ignoring the economic and social differences of local communities. Being one of the major CI scholars, she argues that communities follow a mix of formal and informal, and modern and traditional rules and norms. If informal institutions are ignored, formal institutions become rather empty

shells and decisions are made in other places. Then, inequalities of accessing and distributing water rather increase. Herewith she shows that farmers' participation per se neither improve irrigation management nor contribute to democratization and empowerment. Concluding, she argues that development agencies should move from merely implementing participatory development projects to consider the wider dynamics of economic and social change. That is, to view communities and institutions as more dynamic and account for power relations as well as for the exclusionary and inclusionary nature of participation.

Moving from understanding the nature of participation to the outcomes of participation, Cleaver (2007) aims to better understand how individuals' participation in collective action shape and reshape social relationships and institutions. To enrich the understanding of social relationships and outcomes of collective decision-making, she draws on social theories of structuration, governmentality, and gendered empowerment. Regardless the underlying theory, Cleaver (2007) states that scholars commonly agree that individual actions are relational. However, they disagree about whether social structures enable or constrain interactions. Thus, some argue that individuals' actions are shaped by their cultures and hence constrain agency, whereas others argue that individuals' resources enable them to overcome structural constraints.

However, to overcome structural constraints, people must have resources (Cleaver 2007). The nature of these resources – either being authoritative, implying command over people, or allocative, implying command over things –, constrains or enables peoples' actions. Thus, Cleaver (2007) argues, agency and the possession of resources are linked to general relations of power and the concept of 'governmentality'. That is, the study of organized practices through which we are governed and govern ourselves, where power is exercised through taken-for-granted everyday interactions. Individual agency is then not just a purposive action, but depends on nature and possession of resources.

Moreover, farmers' rationalities and physical capabilities determine agency and thus active participation. Depending on communities' world views, farmers in Tanzania often follow a moral-ecological rationality. How to act and behave then depends on social status, gender, individuals' multiple roles in a community, religion, and natural and supernatural forces. Physical constraints, such as caring for children, sicknesses, or age, may all be reasons which exclude these people from actively participating in irrigation management. Thus, it is not

always clear to what extent people in a community, especially the poor, can choose to negotiate norms and rules and how these enable or constrain individual agency.

Aiming to better understand how institutions work in practice, Cleaver (2007) unites observations of the diverse nature of resources and relationships in the concept of 'institutional bricolage'. Opposing to a conscious, rational or purposely crafted form of institutional design, she describes institutional bricolage as a process of piecing together norms and rules which guide collective action; often mixing, consciously and unconsciously, formal and informal as well as traditional and modern institutions. Cleaver (2007) argues that such plural institutional settings then determine farmers' participation in the field; for instance in communal management of irrigation schemes in Tanzania. Concluding, Cleaver (2007) suggests that in order to create benefits and social justice from development projects, we need to think further about the extent of farmers' active participation in development projects. In addition, one has to take into account the existing inequalities and adapt probable participatory development interventions. Thus, one also has to analyse the various aspects of individual actions and their effects on other actors. That means to expand investigations of decision-making beyond public forums to places where agency is exercised through practice.

An example of how to investigate agency through practice is the work of Lecoutere (2011). To get insight into the functioning of local institutions, she analysed how farmers in the Rufiji Basin in Tanzania solved conflicts over water access and distribution within their irrigation schemes. As mentioned by Cleaver (2007); (2012), the management of irrigation schemes in Tanzania is characterized by a mix of state-introduced formal institutions and local informal institutions. In line with Cleaver's observations, Lecoutere (2011) found out that this institutional pluralism both enables and constrains farmers in managing their irrigation schemes. It improves farmers' irrigation management by allowing to adapt institutions to social and ecological conditions of the community. However, institutional pluralism also allows reinforcing unequal power relations among farmers. The process of problem solving is not necessarily fair or impartial, but rather depends on the social status of the people involved. For example, women and other people with a lower power status are not always able to participate in conflict solving or to actively defend their interests. Thus, Lecoutere (2011) concludes that institutions are products of social processes and the outcomes from introducing formal water rights cannot be predicted. Hence, to ensure social equity, policy makers should

assess how new introduced institutions may support or disrupt local institutional arrangements and how they affect marginalised people.

Summing up, Ostrom focuses on revealing common characteristics of human interaction whereas Cleaver (1999; 2001; 2007; 2012), Cleaver and Franks (2005), and Lecoutere (2011) discuss what enables and constrains human interaction. More specifically, the authors investigate participatory approaches in communal irrigation management and the introduction of formal institutions which is commonly seen as a means to development. The authors challenge this assumption by arguing that farmers' ability to participate not only depends on the institutions in place but also on farmers' resources and social status which are influenced by power relations. Thus, introducing formal institutions and letting farmers participate in irrigation management does not always ensure fair and equal water access and distribution but may reinforce inequalities among farmers.

Concluding and relating to the second objective of this study, mainstream institutionalism as well as critical institutionalism provides valuable tools and explanations for the understanding of how farmers manage their irrigation schemes on a communal level.

However, irrigation schemes do not benefit farmers equally. Therefore, the third objective focuses on the household level and investigates how irrigation management affects farmers' livelihoods and dependency on irrigation. Thus, the next section gives an overview over literature on peasant household economics and rural development, particularly focussing on livelihoods and poverty reduction.

2.3 Institutions and Livelihoods (Obj.3)

Within the field of peasant economies, the sustainable livelihoods approach is a concept and a framework to rural development (Ellis 2000a; Ellis 2000b). The sustainable livelihoods approach developed out of a critique to economic input-output models influenced by general theories and concepts of peasant economies (Ellis & Biggs 2001; Vedeld 2013). Before moving on, we therefore briefly review how the sustainable livelihoods approach (SLA) evolved within the field of peasant economics.

According to Ellis and Biggs (2001), peasant economies were already subject of research in the 1950s. Influenced by dual-economy theories, rural livelihoods and small-scale farming

were viewed as unproductive and thus without potential to contribute to a country's economic development. However, in the 1960s, a first paradigm shift occurred and small-scale agriculture the as seen as the engine for economic growth and rural development. With structural adjustment and market liberalisation of the agricultural sector, a second paradigm shift occurred in the 1980s. 'Blueprint' and top-down approaches to small-scale farming switched to participatory and bottom-up approaches. Herewith, involvement of the rural poor, their local knowledge and their diverse livelihoods came into focus of research as well as aspects of gender and empowerment.

Out of this, in the 1990s, the SLA developed as an integrated framework to analyse rural livelihoods. SLA allows analysing the quantity and quality of resources farmers use to survive within the political and institutional context on village, district, and national levels. That means to investigate which resources and institutions enable or constrain rural households, which are important for accessing resources, and which are important to improve livelihoods sustainably. Hence, SLA is a useful tool both to investigate outcomes of policy changes, as done in this study, and to develop strategies for improving rural livelihoods and thus to reducing poverty (Ellis & Biggs 2001).

However, Ellis (2000b) argues that farming alone is often not sufficient to reduce poverty and thus farmers diversify their livelihoods. Ellis (2000b) argues that diversification of a livelihood can be a result of both pressure and opportunity to a rural household. He further distinguishes between diversity and diversification of livelihoods. While diversity refers to a point in time where rural people use many different income sources, diversification refers to the process of creating diversity. That is, some members of a household give up farming as their main income source and start working, for example as carpenters or employees in the longer term. Thus, analysing the extent of livelihood diversification helps to understand how institutional changes affect rural households, which is portrayed in the study's third objective.

The next section shows four examples of applied SLA, focussing on how institutional arrangements influence the diversification of rural livelihoods. Kadigi et al. (2007) investigate effectiveness of households' coping strategies, whereas Tang et al. (2013), Ellis and Mdoe (2003), and Mutoko et al. (2014) investigate how institutional changes and national policies change rural households to the better or the worse.

Tang et al. (2013) state that in the Loess Plateau, China, institutional changes of the national land policies change rural livelihoods to the better. Changes in agricultural practices, such as terracing of sloped farmland or turning it into orchard, forest and grassland, increase soil quality. Better soil quality allows farmers to grow more different crops and rely less on grain and subsidies. Tang et al. (2013) argue that due to changed agricultural practices, farmers are then able to diversify and increase their income. Thus, institutional changes lead to improved livelihoods and reduce farmers' vulnerability to droughts or heavy rain falls.

In contrast, Ellis and Mdoe (2003) state that in the Morogoro Region, Tanzania, national policies for reducing rural poverty do not change rural livelihoods to the better. Ellis and Mdoe (2003) state that policies do not recognize the potential of local institutions to reduce poverty. Further, the institutions of the public sector are neutral or constraining rather than supportive to poor peoples' livelihoods. For example, high taxation of commodities and enterprises at village level hinder poor households to generate cash and potential investment in improved farming practices and non-farm resources, such as education. Hence, the authors argue that hindering poor households to create cash income reduce economic activities and diversification of rural livelihoods, thus to reduce rural poverty. Concluding, Ellis and Mdoe (2003) suggest to adjust institutions of the public sector in order to enable diversification and thus improve rural livelihoods.

Similar to Ellis and Mdoe (2003), Mutoko et al. (2014) emphasize to enable diversification of livelihoods when analysing land use dynamics in Kenya. Mutoko et al. (2014) argue that with increasing population pressure, farmers tend to expand their fields and pursue off-farm livelihood strategies rather than only intensifying their agriculture. Thus, although not applying SLA but an integrated approach, the authors also point out the importance to create opportunities for livelihood diversification. Development interventions and agricultural policies should therefore not only focus on agricultural income sources but also focus on creating income opportunities in the off-farm sector.

Moving from identifying income sources for rural households to their adaptation strategies, Kadigi et al. (2007) discusses households' responses to institutional and environmental changes. To investigate how effective rural households cope with increasingly scarce water and land resources, they analyse the strategies households use to access these resources in the Great Ruaha Catchment, Tanzania. The authors state that for the poor the most important strategy to access these resources is drawing on social networks and collective arrangements.

Thus, existing institutional arrangements and mechanisms determine poor households' access to resources, hence to diversify livelihoods and reduce their vulnerability. Concluding, Kadigi et al. (2007) suggest facilitating the establishment of formal institutional arrangements, such as water user associations, in order to expand peoples' social networks and thus their access to resources.

Moreover, the analysis of livelihood strategies also serves to support risk analyses, as done by Quinn et al. (2003). They examine peoples' perceptions of risk and factors which influence these perceptions in semi-arid areas of Tanzania. The authors argue that besides environmental factors and gender, also livelihood strategies influence risk perception. For example, communities relying mainly on agriculture as their livelihood strategy are concerned about problems related to irrigation and weather. Pastoralist communities relying on livestock as their livelihood strategy are concerned about problems related to livestock diseases and access to land. Concluding, the authors argue that communities and individuals perceive risk differently, depending on their livelihood strategies. Thus, identifying livelihood strategies and related risks is crucial to develop fitting programs and policies for poverty reduction. Risk-mapping then provides a cost-effective way to gain insight in risk perceptions of local communities, which is crucial when setting up development projects or policy frameworks.

Similarly, Lankford (2003) suggests that policies should not just focus on irrigation expansion for development but be responsive to diverse and local livelihood strategies. Therefore, he combines a river basin with a livelihoods approach. Lankford (2003) examines irrigation development in three stages: a proto-irrigation stage, an irrigation momentum stage, and a river basin management stage. In the proto-irrigation stage, farmers are aware of benefits as well as of costs for irrigation, and hence do not always enter into irrigation activities.

Irrigation development is then not the only means to improve farmers' livelihoods. When irrigation gains momentum, irrigation activities compete with other water uses and means of livelihoods such as rain-fed agriculture. While moving on to the basin management stage, decision-makers should therefore focus on re-allocation of water, conflict mediation, and management of resources rather than on irrigation expansion. Thus, Lankford (2003) argues that policies should not purely focus on irrigation expansion as the only strategy to improve farmers' livelihoods, but should enable diversification of rural livelihoods.

Summing up, Tang et al. (2013), Ellis and Mdoe (2003), Mutoko et al. (2014), Kadigi et al. (2007), and Lankford (2003) argue that institutional arrangements in the form of official rules

and social networks are crucial to reduce poverty in rural households. As official rules they determine opportunities to create income in the on-farm as well as in the off-farm sector to allow livelihood diversification. As social networks they determine households' access to resources and thus the opportunity to create and eventually diversify income. Quinn et al. (2003), however, do not discuss the potential of institutional arrangements to diversify income and reduce poverty, but reveal that livelihood strategies also influence rural households' risk perceptions. Thus, studying livelihood strategies is crucial for identifying potential for poverty reduction and gaining insight into peoples' perceptions of risk.

Concluding, the authors above identify the potential of institutional arrangements for livelihood diversification and thus, poverty reduction. However, they do not study local heterogeneity, that is, how individual households adapt to changes of institutional arrangements in irrigation. Hence, the third objective of this study uses SLA as an approach to investigate how institutional changes in irrigation management affect the economic conditions and individual adaption strategies of rural households.

3 Theory, Objectives and Research Questions

The overall question of this study is to understand what accounts for the gap between national regulations on irrigation and local irrigation practices in Tanzania. Thus, it is to understand farmers' behaviour and the institutional structures which govern their irrigation management in the long term. Therefore, theories of institutions and agency lay the theoretical foundation for the first and second objective of this study, more precisely mainstream institutionalism (MI) and critical institutionalism (CI), which have already been introduced. To briefly recapitulate, MI complies with rational choice and functional assumptions, whereas CI complies with a social constructivist approach. Thus, MI and CI have contradicting views on the role of the individual in society. Yet, both give valuable and commensurable insights into the development and characteristics of institutions, and thus on the relationships between the two. Relationships between actors and institutions are crucial to understand the characteristics of long enduring institutions. That is, why some communities succeed to manage their irrigation systems collectively and others not. Yet, we first have to look at how communal irrigation is embedded in institutional structures of higher levels. Hence, the first part of this chapter introduces a framework for analysing the governance structure of communal irrigation management from basin to village level. In the second part, we then look at how MI's and CI's insights into the characteristics of long-enduring institutions differ. In the third part of this chapter we finally move from discussing institutional characteristics to characteristics of individual households. Thus, we look at the sustainable livelihoods approach as a theoretical foundation for understanding how communal irrigation management affects individual households.

3.1 Analytical Framework

Related to the study's first and second objective, we look at the governance structures of communal irrigation which connect the resources with actors and institutions from the local to the national level. Thus, the following section will give an overview over the framework for analysing natural resource regimes (Oakerson ; Ostrom 2011; Vatn 2011), specifically over each factor represented in the framework and the relations between them. These are the communal institutions as well as institutions at higher levels, the political and economic actors, the natural resource, and the technologies used (Fig.1).

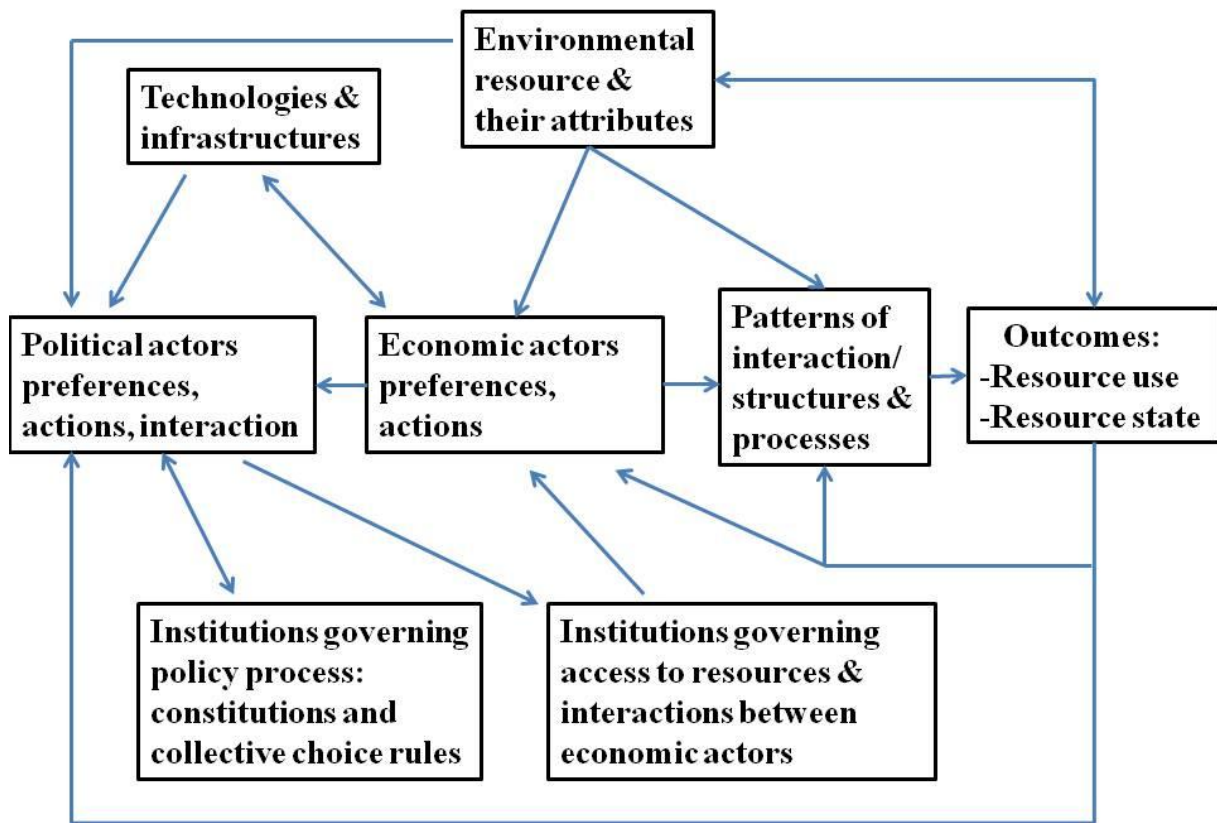


Figure 1: Framework for the analysis of natural resource regimes (Vatn 2011)

Following the framework, we distinguish between two types of institutions: resource regimes, that is, the formal and informal institutions governing the use of the environmental resources to produce goods and services; and institutions which govern the related policy processes (Vatn 2011 p.136). For environmental resources, such as water, the resource regime is the access and interaction rules on the ground. Access rules consist of property and use rights to the resource defined by customary or formal law. Interaction rules govern transfer of the resources or the produced goods between the users, and the distribution of the side-effects of production (Vatn 2011). The institutions governing policy processes and thus, the rule-making from state to local level, are constitutions as well as collective choice rules.

However, institutions are empty shells without actors who define and enforce them. Taking a closer look, we can distinguish between economic and political actors. Economic actors hold access and use rights to the resource and may be private, state or communities. Political actors are the ones who participate in defining the rules for economic actors on local, regional, state, and international level (Vatn 2011).

Putting actors and institutions together, we look at the relationships between them. Relationships between economic actors and resource regimes are either formal or informal, depending on the institutions governing the policy processes and the political actors themselves. Political actors – governments, parliaments, and state agencies – mainly define formal rules, such as property rights, use rights, and regulations on side-effects. In contrast, civil society as a political actor mainly participates in informal rule-making. They develop customary rules for resource use and create norms of good conduct. However, rule-making is not always a conscious process and often reflects preferences and interests of political actors (Clever 2012; Vatn 2011). Yet, political actors depend on and cannot simply overrule economic actors, because they provide their resources, such as public production, taxation, membership fees, and donations. Thus, the actors and institutions, either directly or indirectly interlinked, build the core of the governance structure.

However, a governance structure is not complete without the links to environmental resources, technologies and infrastructures. The technologies and infrastructures directly influence economic and political actors and vice versa. The technology in place influence political actors' rule-making and rules again enable or constrain the development of certain technologies. Similarly, technologies and infrastructures shape preferences and actions of economic actors who again adjust their actions and support or oppose certain technological development. The same holds for the attributes of the environmental resource. Depending on actors' perception of the resource attributes, political actors adjust their policies to the resource attributes, and economic actors their actions and preferences. Last but not least, the actors and resource attributes determine patterns of interaction and thus, the outcomes. The outcomes are on the one hand the state of the resource and on the other hand the way of how the resource is used (Vatn 2011). Closing the circle within the governance structure, outcomes influence resource attributes and actors, who thereupon adjust their preferences, actions, and rules which again result in new governance structures.

Concluding, the structure of the framework allows analysing the relationships between actors and institutions on different levels while taking into account the attributes of the resource and the technologies. Thus, the framework is a valuable tool to structure the analysis of the study's objectives, and particularly help to achieve the first one. That is, to analyse the interlinking of institutions and actors from basin to village level. Following the second objective, we move to the local level, looking at relations between farmers and institutions

around communal irrigation. Therefore, the next section discusses characteristics of long enduring institutions for communal irrigation systems from a mainstream and critical institutionalist perspective.

3.2 Characteristics of Long-Enduring Institutions

Robust and long-enduring institutions are crucial for communities to manage irrigation schemes sustainably. Therefore, Ostrom (1990) identified common institutional characteristics from communities all over the world who successfully managed their irrigation systems in the long term. These institutional characteristics, commonly known as ‘design principles’ (Ostrom 1990), guide the following discussion about characteristics of long-enduring institutions for communal irrigation management. The principles develop from rather simple issues such as determining boundaries of resource and community, to more complex issues such as characterizing the rules-in-use, and showing how communal institutions are nested in larger government structures.

Community, farm, and resource boundaries; resource-access and use-rules

The first principle is to determine the boundaries of the resource and of the community (Ostrom 1990). That is, to know who are the members of a community and how much water is available for irrigation. From a mainstream institutionalist perspective, these clearly defined boundaries facilitate human interaction by enabling community members to know with whom to cooperate, respectively not to cooperate when using their resources (Ostrom 2008). Hence, to know who are the members of a community minimizes transaction costs, that is, the costs of organisation and information, and maximises the benefits of each single farmer (Vatn 2005). Benefits are increased trust, reciprocity, and reliability among community members and less free-riding: more cooperation and less exploitation of the resource (Ostrom 2008).

Yet, from a critical institutionalist perspective, clear boundaries of the resource and the community are difficult to define, particularly in case of water. Hydrological boundaries are dynamic and seasonal and hence not clear: during the dry season the river may dry up and water is not available to the community any more. Thus, farmers may also access water in other communities, often in the ones of their kin (Cleaver & Franks 2005). That means community and resource boundaries are rather fuzzy, they may overlap and farmers also draw on social and cultural networks to access resources. Thus, who is in and who is out of the

community and who to trust or to cooperate with is rather unclear. Concluding, one should be aware that resource boundaries can change throughout the seasons, thus change resource availability and blur community boundaries (Cleaver & Franks 2005). Nonetheless, clearly defined boundaries can be meaningful institutions and facilitate equal water access and distribution in the long-term.

Balancing costs and benefits of resource use

Moreover, long-enduring institutions ensure congruence between appropriation of resources and provision of the same. This means that rules need to specify duties and costs of operating the irrigation systems as well as the benefits, that is how much, when, and how farmers get water (Ostrom 1990). From a mainstream perspective, assuming a rational acting individual, a proportional balance of benefits and costs ensures that farmers perceive the rules as reasonable. Thus, they follow the rules because breaking them would be too costly. Contrasting, critical institutionalists, assuming a relational individual, emphasize that communities are heterogeneous and shaped by power relations among members. Thus, wealthy and powerful farmers are likely to get more benefits from irrigation in relation to what they have to pay for it. Poor farmers, however, often pay more in relation to the benefits they get (Hall et al. 2014). Moreover, external actors and infrastructures may influence community members' balance of costs and benefits. For example, by restricting water use to ensure water for downstream users, community members get fewer benefits from irrigation but still have the same costs. Thus, balancing benefits and costs of resource use depends on potential external restrictions, and on the willingness within the community to make fair rules for all users (Cleaver et al. 2005).

Rule-making for resource-access and use

Thus, to ensure balanced costs and benefits, the community members should craft and modify the rules for resource management themselves (Ostrom 2008). Assuming a homogenous community, mainstream institutionalists argue that these crafted rules serve all members equally. Thus, they perceive rules as fair and make them endure in the long term. Further, community crafting and modifying rules ensures that the latter fit the local resource conditions and management practices. However, critical institutionalists assume a heterogeneous community and questioning the conscious crafting of rules. Thus, they argue that farmers neither consciously craft new and formal rules for the purpose of managing irrigation, nor are they fair to all users. Farmers rather draw on and modify existing

institutions which may serve more purposes than merely irrigation and reflect the power relations among them. Also, not all farmers have the ability to craft or modify their own rules. Either because they are silenced by the local elite or because they lack resources to actively participate in rule-making due to social responsibilities (Cleaver 2007). Therefore, the rules-in-use are not always visible or appear as formal structures but are part of everyday life. Thus, the mere fact of rules being defined by community members does not necessarily ensure rules to be fair to all members; one has to take the power relations among members into account.

Monitoring

Yet, it does not help to define rules, if they are not enforced. Thus, long enduring institutions are characterized by regular monitoring through community members themselves. The elected monitors overview the water use, ensure compliance with the rules, respectively solve conflicts and sanction opponents. They are hence accountable to other resource users. From a mainstream institutionalists' point of view, creating an official monitoring position allows imposing official sanctions on opponents instead of merely relying on local norms; monitors are able to increase the opponents' costs of breaking the rules. Additionally, filling the position with a community member creates a sense of obligation: for the monitor to responsibly fulfil the designated task and for other members to cooperate (Ostrom 2008).

However, this only works in relatively homogeneous communities which, from a critical institutionalists' perspective, rarely exist. Rather, power struggles and issues of participation characterize the election of monitors and the process of monitoring itself. As mentioned, poor farmers often lack the resources to actively participate in election processes or are simply ignored by more powerful farmers (Cleaver 2007). Concerning the monitoring process, farmers may be treated differently depending on their wealth, social status, gender, kinship, or ethnicity. Thus, especially in case of conflict, poor and female farmers are often disadvantaged. However, also monitors may lack resources to fulfil their duties, because monitoring activities coincide with intensive farming activities. Thus, conflicts are often solved among the farmers themselves, sometimes leading to even less fair outcomes than when solved by monitors (Cleaver 2007). Concluding, the election of local monitors and monitoring itself is crucial for the enforcement of the official rules. Yet, informal rules and power relations among farmers are equally influential as monitors often lack time to carry out their duties during the growing season (Cleaver & Franks 2005).

Conflict solving and sanctioning

Moreover, monitoring is only effective when identifying opponents and imposing graduated sanctions. Imposing graduated sanctions is a matter of decision-making, depending on farmers' rationalities. According to the rational choice assumptions of mainstream institutionalists, farmers' decisions follow their stable preferences and calculating behaviour. Thus, sanctions increase in relation to the severity of the offense. The first sanction does usually not affect a farmer's cost-benefit ratio of whether to comply with the rules for resource use or not. It is rather a notification of the infraction to the rule-breaker and the public, assuming that a farmer may unwillingly break a rule. Yet, disclosing farmer's misbehaviour makes other farmers fear to be caught as well and thus already increases compliance with the rules. However, all following sanctions are costly. That is, monitors gradually increase – in relation to the offense – the opponents' costs of breaking the rules, guided by clear and consistent decisions; the sanctions being consequences derived from the offense. Imposing sanctions will thus ensure further cooperation of community members and reduce free-riding hence, lead to effective resource management (Ostrom 2008).

Contrasting, critical institutionalists assume an individual influenced by its social environment. Thus, farmers perceive fellow farmers not as anonymous resource users but as neighbours and kin and try to avoid conflicts rather than provoking them. Hence, approximate compliance with the rules is often sufficient. If it is not, farmers negotiate reconciliation, respectively monitors impose sanctions according to what they perceive as appropriate and according to the ability of the opponent to pay. Thus, monitors and opponents are relational and decision-making becomes a negotiable process. Such socially embedded institutions ensure social trust and relations of reciprocity among farmers, although reinforcing social inequalities, and therefore disadvantage the already marginalized. Concluding, decision-making, respectively monitoring and imposing sanctions is not clear and consistent but rather a social process, shaped by continuous power struggles. Hence, monitoring and imposing sanctions not only serves effective resource management – understood as maximising benefits from resource use –, but also has to maintain trust and reciprocity. Thus, communities have to compromise between effective and socially acceptable resource management (Clever & Franks 2005).

Costs of conflict solving

Regardless, conflicts over resource use and interpretations of rules occur. Communities, who sustainably manage their resources, rapidly solve their conflicts at a low cost. Thus, from a mainstream institutionalist perspective, the monitoring system reduces transaction costs of social organisation. That means monitors follow a fixed set of rules to approach and solve the conflict at scheme or village level. Thus, the monitoring system allows monitors to solve conflicts immediately, in a transparent way, and on the lowest level. Further, simple solutions of conflicts, following mechanisms commonly known in the community, lower the number of conflicts that reduce trust among the members. Thus, they reduce negative effects of conflicts and ensure effective and sustainable management of resources (Ostrom 2008).

From a critical institutionalist perspective, monitoring and conflict resolution is socially costly and subject to power struggles. In order to achieve socially preferable outcomes of conflict resolution, community members are willing to incur transaction costs. That is, using existing social and cultural institutions to maintain livelihood interactions with the offender, and only if conflicts are very severe turning to more formal and transparent institutions. Yet, formal and transparent institutions reflect social inequalities, because they protect the values and interests of the ones who made them. These are usually the wealthy farmers and not the poor, already marginalized farmers. Thus, regardless formal or informal, rules for local conflict resolution are neither fair to all users nor rapid or low-cost, but a socially costly process (Cleaver & Franks 2005).

Links to other resource users and higher government levels

In order to reduce these social costs, external government authorities must recognize the institutions defined by local communities. According to mainstream institutionalists, recognition of communal institutions by external authorities allows the latter to become more effective over time and not only relying on unanimity. Otherwise, dissatisfied members can complain to external authorities, and conflict resolutions then need to be negotiated. Negotiation processes increase the transaction costs of conflict resolution and communal management in general which threatens members' willingness to participate in resource management and reduces trust and reciprocity among them. Thus, the effectiveness of institutions for communal resource management decreases over time. To avoid this, local long-enduring institutions for sustainable resource management are typically nested in ever larger institutions, which govern the interdependencies among the smaller institutions, thus ensure effectiveness (Ostrom 2008).

For critical institutionalists, smaller respectively more local institutions are not clearly separated from higher level government structures in the first place. Thus, recognition of communal institutions by external authorities to increase effectiveness over time is negligible. More important is *how* the communal institutions are nested in higher level government structures. For example, how they relate to issues of scale, water access, and inclusion of other water users within the river basin. Issues of scale derive from the physical size, thus from the natural and communal diversity of the river basin. Physical distance makes it difficult to engage with other communities and they may also face different key issues of water management due to the diversity within the basin. Thus, local institutions may not easily link together on a higher level, and communities are not aware of each other as water users with equal rights to the resource.

If communities are not aware of other water users in the river basin, issues of scale turn into issues of water access. Communities upstream use as much water as they want and with that may exclude other communities from water access further downstream. Higher level government authorities then have to restrict water access for upstream communities in order to ensure water for users further downstream. However, higher level institutions often lack capacities, such as staff, knowledge, and time to equally organize and monitor water use in the communities. Thus, the mere nesting of communal institutions in higher level government structures does not necessarily ensure equal water access within and among communities. It should rather help to balance local concerns of water management with the concerns at a higher level (Cleaver & Franks 2005).

Summing up, from a mainstream institutionalist perspective, institutions for communal resource management endure in the long term when: the resource and its users are clearly defined; users have their own official rules and monitoring systems, which are low-cost and respected by external authorities; and the user community and their institutions are nested in larger government structures which govern interdependencies between communities. On the contrary, from a critical institutionalist perspective, local long-enduring institutions are embedded in social structures and thus not always visible and clear. Their boundaries are difficult to define due to seasonality of the resource and the use of social and cultural networks to access the resource. Rules and monitoring systems are negotiable processes and thus subject to power relations and influenced by external authorities.

Concluding, mainstream institutionalists characterize long-enduring institutions as formal, clear, and effective, whereas critical institutionalists characterize them as informal, diverse and dynamic, reflecting the communal heterogeneities and power relations among members (Table 1). Yet, both perspectives give valuable insights into the functioning of communal institutions and thus, into relations between farmers and their institutions.

Moving from institutional characteristics to characteristics of individual households, the next section introduces the sustainable livelihoods approach. In line with CI, the sustainable livelihoods approach reveals the heterogeneity of rural communities and thus, shows how institutional changes affect households differently.

Table 1: Institutional characteristics based on Ostrom (1990), Cleaver (1999); Cleaver et al. (2005); Cleaver (2007); Cleaver (2012); Franks and Cleaver (2007)

| Institutional characteristics | Mainstream institutionalism | Critical institutionalism |
|---|---|---|
| <i>Rules for water access and use as well as farm boundaries are clearly defined.</i> | Rational choice, functional assumptions, homogeneous community -Facilitate human interaction by enabling community members to know with whom to cooperate/not to cooperate when using resources. -Minimizes transaction costs (costs of organisation and information), maximises benefits of farmers (more trust, reciprocity, reliability, less free-riding) | Relational individual, socially constructed, logic of appropriateness, heterogeneous community -Clear boundaries of the resource & community difficult to define. -Thus, boundaries fuzzy and may overlap. -Additionally, farmers also draw on social and cultural networks to access water. |
| <i>Farmers get enough water to irrigate their crops at all times, rules for water access and distribution are fair, duties and benefits of irrigation are balanced.</i> | -Proportional balance of benefits and costs ensures that farmers perceive the rules as reasonable. -Farmers follow the rules because breaking them would be too costly. | -Rules not fair: irrigation benefits wealthy farmers more in relation to what they pay than poor farmers. -Balancing benefits and costs of resource use in the long term depends on external guidelines and on willingness of the rule-makers within the community |
| <i>Rules for water access and distribution are made by irrigators themselves.</i> | -Formal rules for irrigation fair when crafted by community themselves & rules fit local resource conditions and management practices, thus serve all members equally and endure in the long term. | -Farmers neither consciously craft formal rules for managing irrigation nor are they fair to all users. Farmers draw on & modify existing institutions, institutions multifunctional, reflect the power relations among farmers. |
| <i>Monitoring of irrigation schemes is done regularly and in a fair way by other irrigators of the community.</i> | -Creating official monitoring position allows imposing official sanctions and increase costs of breaking rules. -Filling the position with a community member creates a sense of obligation | -Power relations among community members and issues of participation characterize election of monitors and monitoring activities. In case of conflict, poor or female farmers disadvantaged. -Monitors may lack resources to fulfil their duties, |

| | | |
|--|---|--|
| <p><i>The sanction system is fair in relation to the offense and to all water users/Issues of decision-making</i></p> | <ul style="list-style-type: none"> -Monitoring/sanctions follow clear, consistent decisions, sanctions are consequences from offense. -Farmers anonymous and rational actors. -Imposing sanctions ensure further cooperation of community members and reduce free-riding | <p>because monitoring coincides with intensive farming activities</p> <ul style="list-style-type: none"> -Approximate compliance with the rules is sufficient to avoid conflict and public confrontation. Farmers rather negotiate reconciliation/impose sanctions acc. to what is appropriate, and acc. to ability of the opponent to pay. -Decision-making negotiable process, socially embedded. --Institutions ensure social trust and relations of reciprocity, therefore disadvantage the already marginalized. |
| <p><i>Conflicts are solved on village level</i></p> | <ul style="list-style-type: none"> -Conflicts rapidly solved at a low cost. -Monitoring system reduces transaction costs of social organisation. -Solutions of conflicts are simple and follow mechanisms commonly known in the community | <p>Monitoring & conflict resolution socially costly, subject to power relations. Farmers incur transaction costs to achieve socially preferable outcomes of conflict resolution.</p> <ul style="list-style-type: none"> -Only if conflicts very severe, turn to formal/transparent institutions. But also formal/transparent institutions reflect social inequalities, because they protect values/interests of the ones who made them |
| <p><i>Irrigators can organize and adjust their rules to their needs which are recognized by the village government and external authorities.</i></p> | <ul style="list-style-type: none"> -Communal institutions become more effective over time if recognized by external authorities. | <ul style="list-style-type: none"> -Communal institutions not as clearly separated from higher level government structures. -No ideal institution which could increase effectiveness over time. Rather nested/dynamic institutions. |
| <p><i>Rules made by irrigators are embedded in institutional frameworks of the village government, district and river basin authorities.</i></p> | <ul style="list-style-type: none"> -Rules govern interdependencies between higher level and communal institutions in order to ensure effectiveness of institutions for communal resource management over time. | <ul style="list-style-type: none"> -Communal institutions nested in higher level government structures, related to issues of scale, water access, inclusion of water users within the river basin. -Balance local concerns of water management with the concerns at a higher level. |

3.3 Sustainable Livelihoods Approach (SLA)

As mentioned, SLA developed out of a critique to economic input-output models (Vedeld, 2013). It allows assessing farmers' monetary and non-monetary resources, called assets, and the activities which combine these assets to create livelihood strategies. Further, SLA allows assessing the outcomes for households' livelihood security and the environmental resource, while considering households' vulnerability and the related political and institutional contexts (Fig.2) (Ellis & Biggs 2001).

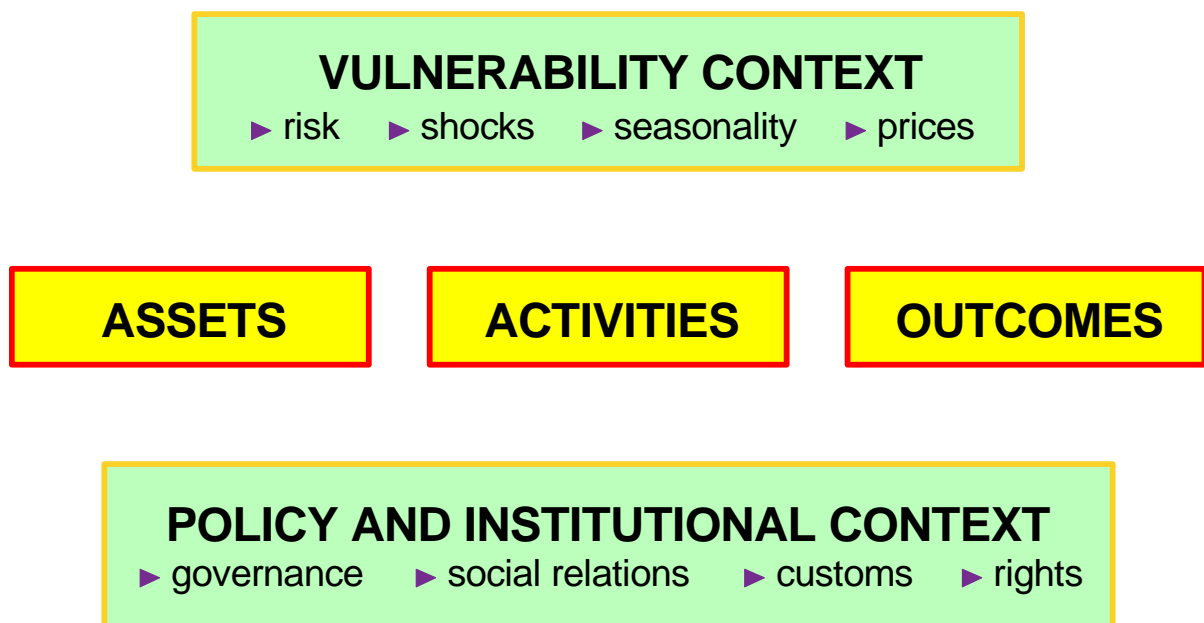


Figure 2: Livelihoods framework simplified from Ellis in Vedeld (2013)

Assets

Assets are the potential resources a household owns, controls, claims, or accesses in order to make a living. More precisely, there are five types of assets: natural, physical, human, financial, and social assets which enable a household to produce, to participate in labour markets and exchanges with other households. Natural assets refer to environmental resources which are non-renewable or renewable, such as coal, petroleum, and natural gas, or agricultural land, forest, water, and livestock. Thus, natural capital can increase or decrease over time, depending on its characteristics and use. Physical capital is usually created through economic production processes and includes for example buildings, machines, tools, infrastructure, irrigation, power lines and roads. Especially irrigation is an important physical

asset as it has the potential to secure and ensure food production in dry periods and throughout the year. Moreover, physical assets can substitute for or take the pressure off some natural capital while increasing human capital. For example, water pipes substitute open water canals and thus reduce leakage and evaporation while saving labour time, providing clean drinking water and thus, reducing illnesses (Ellis 2000a).

Indeed, human capital constitutes the labour force available to the household and its education, skills, and health. Thus, human capital is often one of the most important assets for rural households to ensure livelihood security and facilitate diversification. However, it is also one of the most vulnerable, because it constantly undergoes changes and depends on other assets as well as on policy trends. Thus, demographic factors, such as birth, death, illnesses, aging, marriage, divorce, and migration constantly influence the household, as well as the availability of public schools and hospitals and the households' financial capital. Financial capital is the money a household can access to pay for example for medication, higher education or trainings. Thus, although not productive, financial capital is easy to substitute into other forms of capital and allows quick responses to changes and natural shocks and diseases. However, rural households do not always hold financial capital in form of cash savings but convert it into other forms: livestock, food stocks, gold, or jewellery which can be easily returned into cash if needed (Ellis 2000a).

Finally, rural households depend on social assets, that is, family networks and social relations within the community. More precisely, households get support and access to other capitals based on relations of reciprocity and trust between family, kin, and close friends. This implies that social capital is more than a mere production factor; it gives meaning to a households' social world and determines peoples' power (Bebbington 1999). Thus, social capital is often hidden and subject to unequal power relations among households and hence, difficult to assess and to measure.

Summing up, assets differ in quantity and quality from household to household and can be used directly or indirectly, converted or substituted. They offer capability to be and to act and ensure survival and active participation in society (Bebbington 1999; Ellis 2000a). However, a household must be able to access these assets, which does not only depend on the household itself but also on the institutional, political, and economic context as well as on potential environmental shocks and diseases.

Assets in institutional and political contexts

Following Ellis (2000a), we distinguish between two broad categories influencing access to assets and the transformation of them into livelihood strategies. Social relations, institutions, and organisations build the first category, demographic, political, and economic trends and natural shock factors the second one. Social relations, institutions, and organisations are mostly factors which are endogenous to the household or the community, whereas the trend and shock factors are rather exogenous (Ellis 2000a). However, what is depicted as endogenous or exogenous also depends on the point of view. For example, for a household the district council may be an exogenous institution, but for a state minister an endogenous institution. Nevertheless, distinguishing between endogenous and exogenous factors can be useful when analysing the influences on a household's asset access and transformation (Ellis 2000a).

In case of this study, we take the standpoint of a rural household; thus, institutions, organisations, and social relations are rather endogenous factors, trends and shock factors rather exogenous. Social relations refer to the social positioning of an individual or a household within the community and include factors such as gender, caste, class, age, ethnicity, and religion. Thus, the importance of each single factor differs from one society to another and may further overlap with the social capital of a household (Ellis 2000a). Institutions refer to the formal and informal structures governing peoples' behaviour; that is, the access and use of assets, and the related policy processes (Vatn 2011). Finally, organisations are groups of actors who aim to achieve certain objectives depending on their institutional framework and the resources they have. On local level these are typically village governments, NGOs, and associations. Thus, social relations influence households' asset access through social status and power; institutions influence through governing behaviour and use of assets; and organisations through enforcing rules while reflecting the continuous power struggles within the community.

Moving from endogenous to exogenous factors, we look on how demographic, political, and economic trends and natural shock factors influence households' access to assets, thus their degree of vulnerability. Demographic trends, such as population growth and density as well as in and out-migration, influence asset access directly through competition and indirectly through altering social relations. Economic trends refer to: development of agricultural technologies and relative prices, economic growth in general, and growth of non-farm

activities in particular. Moreover, economic trends are often influenced by political trends. These are international and national macro policies which help or hinder the development of certain economic trends on lower levels (Ellis 2000a). For example, policies subsidizing agricultural inputs for export-crops, facilitate intensification of export-crop production on small-scale. Hence, also policy trends alter households' access to assets and asset transformation and thus, determining the vulnerability of a household. That is, the household's ability to cope with natural shocks and diseases.

Natural shocks and diseases are particularly challenging, because they have the potential to destroy assets directly and indirectly, and often occur suddenly and unforeseen. Direct shocks are droughts, floods, hurricanes, livestock and human diseases destroy assets directly; enforced sales and disposals are a consequence of the former and thus, destroy assets indirectly. Hence, shocks have short-term as well as long-term effects on households' vulnerability. Together with the other endogenous and exogenous factors, these effects differ depending on the severity of the shock itself, the households' initial economic condition, and the households' livelihood and coping strategy.

Activities and livelihood strategies

Livelihood and coping strategies are the activities which link assets and outcomes, influenced by the mentioned endogenous and exogenous factors. Depending on the assets, we can distinguish between natural resource based and non-natural resourced based activities. Natural resource based activities include food and cash crop cultivation, hunting and gathering, livestock keeping and pastoralism, as well as non-farm activities such as brick making, weaving, and thatching. Non-natural resource based activities include rural trade of farm outputs, inputs and consumer goods; other services such as vehicle repair and rural manufacture; remittances and other transfers such as pensions from past former employments (Ellis 2000a). Thus, by combining and substituting assets, activities create different types of livelihood strategies which can be grouped as follows: agricultural intensification or extensification, livelihood diversification, or migration. Agricultural intensification or extensification refers to increased respectively decreased reliance on agricultural activities, resources and access to land. Livelihood diversification refers to increased reliance on various activities in the farm, off-farm, and non-farm sector, and migration refers to a livelihood strategy which relies on changing localities in order to get access to new assets.

However, which type of livelihood strategy households choose depends on households' abilities to substitute available assets and on their motivation to generate certain outcomes. Households' abilities to substitute assets depend on the institutional and political framework surrounding the household, while households' motivation to act depends on peoples' rationalities. Thus, motivation depends on assumptions about whether people act to maximise their own utility or according to what they perceive as socially appropriate. Asset substitution refers to the household's ability to convert one type of assets into another. Thus, if a household has a high ability to substitute assets, it can diversify livelihoods, hence adapt to shocks and policy changes, and achieve desired outcomes.

Outcomes

Outcomes concern environmental sustainability and livelihood security. Livelihood security refers to income levels, income stability, and reduction of income seasonality and of overall risk. Depending on the level of livelihood security, households are more or less able to cope with adverse trends and shocks, thus become more or less vulnerable. Environmental sustainability relates to quality and availability of soil and land, water, rangeland, forests, and biodiversity. Thus, outcomes influence the state and the resilience of natural resources. Moreover, both types of outcomes affect each other; the sustainability of natural resources determines the availability of assets, hence households' livelihood security (Ellis 2000a). Thus, outcomes can accumulate capital over time and build assets, and also deplete assets of the household, depending on use and management.

Summing up, the sustainable livelihoods approach helps us to identify the main components of a rural livelihood – the assets, the related institutional and political frameworks, and activities – and the links between them (Ellis 2000a). SLA is thus a valuable tool to investigate households' economic conditions as well as the affects of institutional changes on individual households. However, being the unit of interest, we have to take a closer look at the economic definition of the rural household, respectively the peasant farm household.

The peasant farm household

Following Ellis (1993), the major differences between a peasant farm household and other farm households lie in the features of their farming enterprise and in the social characteristics of peasant societies. Peasant societies are often defined as transition-societies, standing between isolated and self-sufficient communities and fully integrated market economies (Ellis

1993). Thus, while farming for subsistence, peasants are always part of larger economic systems, and are thus exposed to the market forces. Hence, their inputs and outputs are valued within the wider market at prevailing prices. This provides opportunities and pressures for the peasant farmers; they have to balance between engaging in markets and taking the risk of market failure, and farm for subsistence to ensure survival (Ellis 1993).

This further characterizes peasant societies as being subordinated either to unequal power relations within the community or to external forces. External forces, such as the exercise of unequal power in imperfect markets puts peasants at a disadvantage, as well as adverse price trends, because peasants are unable to compete with world market prices. However, also the different and dynamic social statuses within communities cause exploitation through non-market coercion, constituting another social characteristic of the peasant society (Ellis 1993).

Moving on, we distinguish peasant farm households according to characteristics of the farm enterprise. More precise, we look at economic activities, resources, labour, and consumption patterns which distinguish the peasant farm enterprise from other economic actors in the market economy. Peasants are mainly farmers and their main economic activities are cultivating crops and raising livestock. Further, a peasant farm household is both family and enterprise, thus engaged in both production and consumption activities. Nevertheless, they may engage in non-farm activities but keep farming as their predominant activity. Hence, peasants' main resources are land and water resources. However, the allocation of these resources typically follows customary or traditional laws. Thus, land and water resources become more than just production factors; they are life insurance, part of peasants' identity, and determine their social status (Ellis 1993).

Moreover, a peasant farm household mainly relies on family labour. This does not exclude the possibility to hire or sell labour. However, it clearly distinguishes the peasant enterprise from a capitalist one. A peasant farm household is both producer and consumer, which makes it difficult to separate ownership of the means of production from labour, and distinguish profit from returns. Similarly, a peasant farm household may purchase capital inputs for both production and consumption purposes and thus, calculating a rate of return to capital is not possible and becomes another point of difference.

Finally, a peasant farm household is characterized by its partial integration into imperfect markets. Partial integration refers to partly producing for a market and partly for subsistence,

that is, the household directly consuming farm output rather than selling it. However, the share integrated into the market differs. Hence, it also differs how much peasant households suffer from imperfect markets (Ellis 1993). Imperfect markets, compared to hypothetical perfect markets, reflect the inequalities of market trade. Thus, on imperfect markets information is costly and incomplete favouring the ones who have information over the ones who do not. Similarly, some actors have more economic power than others which may increase or decrease the price levels. Thus, the ones with less resources and capital are often disadvantaged. Moreover, markets are incomplete, meaning that they exist only seasonally, are unstable due to general economic collapse which results in erratic availability of goods, or due to poor transport and communication.

Thus, putting the social characteristics and the characteristics of the farm enterprise together, the economic definition of a peasant farm household is as follows: “Peasants are households which derive their livelihoods mainly from agriculture, utilise mainly family labour in farm production, and are characterised by partial engagement in input and output markets which are often imperfect or incomplete.” (Ellis 1993; p. 13).

Finally, we shall take a brief look at how peasant societies may develop in the futures when accumulating capital over time. Based within the broad field of political economy, peasant economies may develop either towards consolidation or towards social differentiation (Ellis 1993; Ch. 3; Vedeld 2013). The ‘consolidation school’ suggests that peasant communities remain or develop into rather homogeneous entities when capital accumulation remains rather difficult. More specifically, societies develop towards consolidation when peasants maintain production levels and ensure redistribution within the community, when there is low profitability and strong institutions of reciprocity and little options to invest into agriculture (Vedeld 2013). The alternative direction of development is social differentiation (Ellis 1993). Due to peasants’ different abilities to access assets and to accumulate capital, influenced by social status and power relations, peasant societies may split into a group of (natural) capital owning farmers on the one hand and a group of landless workers on the other (Vedeld 2013). Thus, the political and institutional contexts, including investment incentives and development programmes, which surround peasant farm HHs shape not only the current state of the HH but also peasant societies’ future development.

Having defined the peasant farm household and discussed their potential future development as well as rural livelihoods, characteristics of long-enduring institutions for communal

irrigation management, and the overall framework for analysing water governance systems, we can now take a look at how these shape the study's objectives and research questions.

3.4 Objectives and Research Questions

This section presents the three objectives and related research questions, each informed by theory and shaped by conclusions derived from the literature review. On our way to understand what accounts for the gap between national regulations on irrigation and local irrigation practices in Iringa Rural District, Tanzania, the framework to analyze natural resource regimes (Fig. 1, section 3.1) serves as an overall structure. It supports the study's analysis of relations across levels as well as on communal and individual level, ensuring that all relevant factors are taken into account.

However, the first focus of this study lies on cross-level relations between political actors and institutions in the irrigation sector. As the literature review indicates, investigation of the links between institutions across levels lacks research, especially in areas where water is scarce and farmers highly depend on irrigation agriculture. Thus, we first identify how water is allocated and how the management of irrigation systems work across levels in Iringa Rural District.

The first objective therefore aims to investigate the resource attributes and the infrastructure in place, as well as the interlinking of water governance structures from district to village level. This is reflected in three following research questions:

RQ 1: How is water in the Great Ruaha river basin allocated between the domestic, environmental, and economic sector? And what are the attributes of the Little Ruaha river?

RQ 2: What kind of infrastructure is in place to distribute water from the river to the village farms?

RQ 3: Who are the political actors defining the irrigation regime and policy processes for irrigation management in Iringa Rural District? And according to what types of institutions do they act?

The second focus of this study lies on institutions of communal irrigation management in practice. Communal irrigation management is shaped by local norms and customary laws as well as by Tanzania's current water policy. In order to improve water access and sustainable use, the water policy follows a top-down approach, formalizing the institutions of communal

irrigation management and directly involving water users in the management on the ground. However, Cleaver (2012) argues, institutions designed at a national level often lack legitimacy at local level. They do not serve local needs and are not socially embedded in the local community (Cleaver 2012). In order to understand why the water policy lacks implementation, the study takes on a bottom-up approach by exploring farmers' perceptions of the water policy. This means to look for institutional characteristics of the existing institutions of irrigation management, bearing in mind the different views of mainstream and critical institutionalism. Thus, the second objective seeks to analyse the relationships between farmers, institutions, and the resource in two villages of the district. This is reflected in the following research question:

RQ 4: Following the different views of MI and CI, which characteristics apply to the current institutions governing irrigation in the two schemes and how do they differ between the two schemes?

The third focus of this study lies on irrigation and livelihoods of peasant farm households. The reformation of the water sector and increased competition over water leaves farmers in Iringa Rural District with restricted water use for irrigation. However, as critical institutionalism suggests, communities are heterogenic and thus, restrictions on water use affect households differently. Therefore, the third objective seeks to analyse how institutional changes in the irrigation sector affect the livelihood strategies and economic conditions of peasant farm households, with three accompanying research questions framing the analysis:

RQ 5: What are the households' main assets to ensure their livelihoods?

RQ 6: What are households' main income activities and how do farmers in the study area adapt to the formalization of the communal irrigation regime?

RQ 7: Does the formalization of the irrigation regime and the dependency on irrigation lead to improved livelihood security and sustainable resource use?

By taking farmers' as well as officials' point of view into account, this study aims to gain a holistic understanding of the current problems, implementation status, and effects of the water policy on the ground. Hence, it seeks to provide policy makers with future recommendations of how to improve irrigation management for farmers.

4 Study Area and Methodology

This chapter gives an overview over study area and methodology. The first section presents location as well as climate, land, and water resources in Iringa Rural district in general. It then briefly presents history, agriculture and irrigation in the studied villages in particular. The second section introduces the critical realist perspective as the wider philosophical approach of this study and also lays a foundation for the mixed methods used in this study. It closes with an outline of the research plan, consisting of population and sampling, instrumentation, and an analysis plan including ethics and limitations. Before moving on to the description of the study area, one has to mention that this study is part of the research project ‘Enhancing Pro-poor Innovations in Natural Resources and Agricultural Value-chains’ (EPINAV). EPINAV is a joint project between the Norwegian University of Life Sciences (NMBU), Ås, and the Sokoine University of Agriculture (SUA), Morogoro, Tanzania (Boddens-Hosang 2011). In particular, this study contributes to the EPINAV objective “Institutional evolutions at macro and micro-levels in the management of water catchments and their influences on local community livelihoods under a climate change scenario in Tanzania”.

4.1 Study Area

Location and climate

The research was conducted in Itunundu and Mboliboli villages, about 70km from Iringa Town, the capital of Iringa region in south-west Tanzania. Iringa region borders Singida and Dodoma regions in the north, Morogoro region in the east, Ruvuma region in the south and Mbeya region in the west. In the lowland zone of Iringa region, encompassing the riversides of the Great and Little Ruaha rivers lies Iringa Rural District with altitudes ranging between 900m and 1200m above sea level (Ngasongwa 2007). Both villages are located in Iringa Rural District, more precisely in Itunundu ward, Pawaga division, about 10km away from each other (Population Census 2013). The climate of Iringa Rural District is semi-arid with temperatures varying between 20°C to 25°C throughout the year and low rainfall ranging between 500 and 600 mm per annum (557mm in 2012) (Ngasongwa 2007; Tanzania in Figures 2012. 2013). Iringa rural District is characterized by unimodal rainfall pattern from November to April, due to the south and northward moving Inter-Tropical Convergence Zone (ITCZ) (Mbululo & Nyihirani 2012).

Land and water resources

Iringa Rural District has a total area of 2,057,600 hectares of which 440,158 hectares are arable land (Iringa District Council 2013). The rest is used otherwise, mostly as reserved land (65%) in form of a National Park, a Game Reserve, and a Wildlife Management Area. Currently 100,064 hectares are under livestock grazing land while 193,364 hectares (44% of arable land) are under cultivation of various crops (Iringa District Council 2013). Soils are mainly red brown loams and highly fertile (Ngasongwa 2007); however, some farmers in the villages reported about infertile soils.

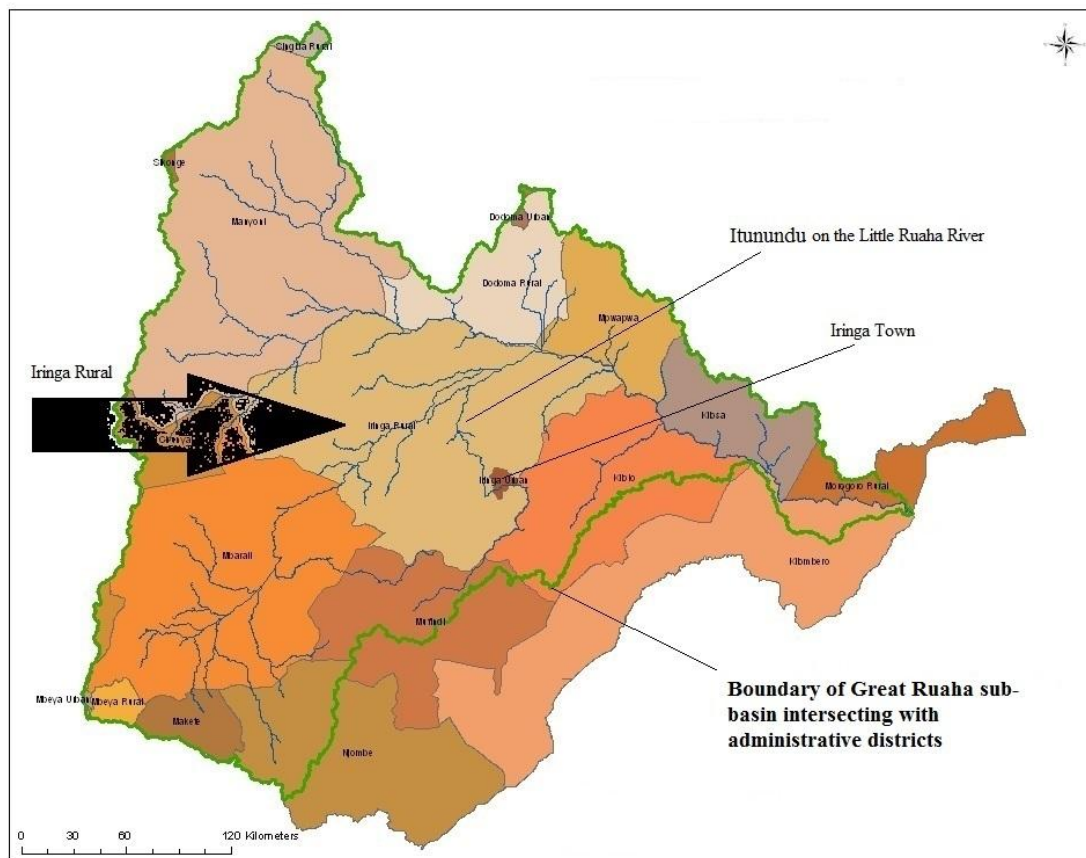


Figure 3: Great Ruaha sub-basin (green line) and administrative districts (coloured legend) (RBWO staff 2013)

Iringa Rural district is further located in the Rufiji River basin, the greatest of Tanzania's nine water basins, covering about 20 percent of the mainland. The Rufiji Basin is divided into four sub-basins, one of them the Great Ruaha basin (Fig. 3) (Ngasongwa 2007).

The water source for the studied villages in Iringa Rural district is the Little Ruaha river, a seasonal tributary of the Great Ruaha river. The Little Ruaha river has its source in Mufindi and Kilolo districts and supplies Iringa Town with drinking water before it passes the studied

villages and drains into the Great Ruaha river. The rivers join right after the Great Ruaha river passed the Ruaha National Park and before reaching the biggest hydropower dam at Mtera, which provides more than 50 percent of the country's hydropower grid (Kadigi et al. 2008; SRESA 2013). Within Iringa region, Iringa Rural District has the largest share of land area (38.5%) but the smallest share of water area (9.4%). Thus, with Ruaha National Park and Iringa Town upstream, and the hydropower plant at Mtera downstream, the villages experience strong competition over water (Ngasongwa 2007).

Ethnicities and Population

The main indigenous ethnic group in Iringa Rural District has been the Wahehe, recently accounting for 43 percent of all indigenous people in Iringa region. However, due to increasing shares of land being under protection at national level and the high agricultural potential, other ethnic groups from all over the country have migrated to the district, especially in the past two decades. Namely Wamasai, Wasukuma, Wagogo, Wafipa, Wabena, Wachagga, Wazagala, Wandengeleko, and Wanyamwezi (Ngasongwa 2007; own data 2013). Thus, the total population of Iringa region is 941,238 people with an annual intercensal growth rate of 1.1 percent, far less than the country's average (2.7%). Iringa Rural District has 254,032 people with an average household size of 4.2 people (Population Census 2013). Thereof, Itunundu village has a total population of 5,000 people and an average household size of 4,4 people; and Mboliboli village a total population of 4017 people and an average household size of 5.1 people (own data).

History, Agriculture and Irrigation in the villages

According to village elders in Itunundu and Mboliboli, the villages existed before Tanzania became independent in 1961. After independence came *Ujamaa* (swahil. unity), also known as African Socialism; villagisation took place and infrastructure and *mashamba ya Ujamaa* (swah. community farms) developed. Harvests from the community farms were sold in community shops. However, community farming and selling the products in community shops were based on moral commitment to African Socialism (Coulson 1982). According to the village elders, the shop owners misused the money and together with the country's economic crisis in the 1980s, villagers returned to only cultivating their private farms.

Before independence, farmers in the villages mainly cultivated crops such as maize and other crops which depend on little rain; paddy was only farmed rain-fed and on small scale. Since

the 1950s, paddy production in the villages has increased due to high prices and is the main irrigated crop cultivated until today. According to village elders, there was no irrigation in the 1930s but it started before independence (1961). In 1969, the Food and Agriculture Organization (FAO) reported about irrigation activities in the area and suggested plans to build Pawaga irrigation scheme, also known as *Mlenge* scheme. Mlenge scheme was finally build in 1992 along the Little Ruaha river, with a semi-improved intake and a canal system reaching about 45km and serving an area of 4217 ha by today. The government constructed the semi-improved intake while villagers had to dig canals under the strict instructions of the village leaders. Mlenge scheme was improved in 2005 and has been used by seven villages; one of them being Itunundu. Itunundu has further used a traditional irrigation scheme, *Mkombozi*, which was also built in the early 1990s by the villagers of Itunundu and Mboliboli who used it ever since. Mkombozi is a traditional scheme with an intake located in Itunundu village built every year out of rocks, sandbags, and branches. The scheme has two subdivisions which both go to Mboliboli area. One goes first through Itunundu area and passes the prison whereas the other one, *Kikeo*, goes directly to Mboliboli area; the scheme covers an area of about 3000 ha.

Farming cycle of irrigated paddy

Due to official restrictions on water use in the dry season, farmers in Itunundu and Mboliboli cultivate paddy only once a year. The farming season starts in late November with cleaning of the irrigation canals in community action. The main canal is cleaned by an excavator which is hired by the village irrigation committee. There is a sexual division of labour in that men clean the secondary and tertiary canals whereas women do not clean at all or only do the small canals leading to the farms. At about the same time, farmers start preparing the land; ploughing and further seed bed preparation, mostly using simple hoes and oxen, only few use tractors or power tillers. In December and January they start planting the seeds in nurseries which require the first irrigation. After transplanting the seedlings to the field, farmers are left with weeding and supervising their crops. In May, respectively five months after planting, the paddy is ready to harvest.

The two villages heavily rely on irrigated paddy production using both a traditional and a semi-improved irrigation scheme. They face ecological, social, and political challenges: the semi-arid climate, strong water competitors upstream and downstream, poor irrigation infrastructure, a growing population, and the reformation of the water policy. These affect

their daily irrigation activities and livelihoods as well as their irrigation management in the long term which makes them a place worth to study.

4.2 Methodology

This section briefly discusses the rationality of using a mixed methods approach, based on the critical realist philosophy of social science. The section continues by presenting population and sampling, procedures and time frame, instrumentation and analysis plan, to then close with some reflections on ethics and limitations.

Methodology and Research Design

This study is embedded in the critical realist philosophy of social sciences. The critical realist movement developed in debate with several philosophical approaches, from positivism to post-modernism, including hermeneutics, neo-Kantianism, and pragmatism (Lagardien 2011 p. 1). As the ‘founding father’, the British philosopher Roy Bhaskar described critical realism as a ‘philosophical switch’: from epistemology to ontology, and within ontology from events to mechanisms. Thus, instead of asking how knowledge is possible, critical realists ask about the properties which society and people must possess to make them possible objects for knowledge. And instead of asking about the events themselves, they ask about the mechanisms that produce these events (Danermark et al. 2002 p.5).

However, before asking about the nature of the mechanisms, one has to ask about where these mechanisms occur, that is asking about the nature of reality. Drawing on Bhaskar’s work, Danermark et al. (2002 p. 20) claim three ontological domains of reality: the empirical, the actual, and the real. The empirical domain is the reality which we experience directly or indirectly. The actual domain is the reality where events happen, whether we experience them or not. And the real domain is the reality where events are produced, that is, where underlying mechanisms and social phenomena occur. Thus, critical realists recognize both a reality which can be experienced through the empirical domain, and a reality existing independently of our knowledge of it. In order to attain explanations about social phenomena, the core of the research process then becomes the relation between the real world – as being structured, differentiated, stratified, and changing – and the concepts we form of it (Danermark et al. 2002 p. 15). Thus, from a critical realist perspective, social science is the production of knowledge through conceptualization of social phenomena.

However, before looking at the process of conceptualization, we briefly need to define knowledge and the objects of knowledge. The knowledge we have consists only of a set of theories about social phenomena, not of the phenomena themselves (Danermark et al. 2002). And likewise, this set of theories is mediated and dependent on already existing theories and concepts, yet not determined by them. The objects of knowledge, the facts, are the social phenomena or mechanisms when we observe and experience them. Together with the set of theories about these mechanisms, facts form what critical realist call *transitive* objects of science. Transitive objects indirectly link science with reality and constitute the raw material researchers use in their practical work. Their counterparts are then so called *intransitive* objects, the social phenomena themselves, existing regardless of our knowledge of them. In case of this study, the intransitive object is the process of rule-making for communal irrigation, taking place regardless of our knowledge about it. Participation in rule-making for communal irrigation is then a fact which together with theories of critical and mainstream institutionalism constitutes the transitive objects. Thus, the objects of social science research are both socially constructed and real (Danermark et al. 2002).

Scientific conceptualization is then the process of breaking down the transitive objects in their components to explain and understand their constitution and way of working. That is for example, trying to understand whether and how farmers participate in rule-making. From there, one infers and creates scientific concepts. However, the process of breaking down the objects and inference follows different logics (Danermark et al. 2002). For this study, induction and abduction are relevant ways of inference and are thus discussed further. Inductive logic starts with something known and draws conclusions that reach beyond the known. Thus, induction is not strictly logic and implies that the definition of reality matters. In practice this means that the researcher observes a representative sample of the village population, which belong to the *empirical* domain of reality. Thereof she or he draws a conclusion which then holds for a higher number of objects or for another point in time.

Hence, scientific concepts are empirical generalizations which follow from a premise but also contain new knowledge. The uncertainty of these generalizations, given different assumptions, is then analysed with help of statistics. In this study, inductive logic is used when interviewing 40 households of a village about their income sources. A conclusion is thereof drawn to see how much the whole population of the village depends in income from irrigation. However, in social science, induction has both a strength and a weakness

(Danermark et al. 2002). The strength is the emergence of new knowledge through inference which is not strictly logic. The weakness is high uncertainties of generalizations of social phenomena which occur when reality is defined as differentiated, stratified and changing. Nevertheless, induction gives valuable insight in the empirical domain of reality.

Yet, objects of science are also part of the real domain of reality in form of structures and mechanisms which are not given in empirical data (Danermark et al. 2002 p. 87). Thus, abduction complements the scientific conceptualization of this study. Abductive logic concerns creative reasoning and formulation of new ideas about the interconnection of social phenomena. Hence, abduction could be seen as a ‘thought operation’, drawing conclusions from and uncover general structures and concrete individual phenomena that are not given in individual empirical data (Danermark et al. 2002). The challenge is however, to know what makes an individual concrete phenomenon a manifestation of underlying general structures. That is, to know why the location of a concrete water intake of an irrigation scheme is an embodiment of certain power structures between local communities and higher level governments. Therefore, one applies a rule or a set of ideas, that is, a frame of interpretation or a theory, to an individual phenomenon to then draw a conclusion thereof, that is, a new interpretation of this individual phenomenon. Thus, abduction, although always fallible, provides deeper knowledge about a case of study, and enables to gradually test and modify theories by relating them to ever new cases (Danermark et al. 2002). Compared to a positivist approach for example, which is exclusively based on the empirical domain of reality and strictly causal explanations, critical realism goes further: it reaches beyond the purely empirical domain and offers a deeper and more holistic investigation of the case at hand (Danermark et al. 2002).

Summing up, critical realists view reality as structured, differentiated, stratified, and changing. Hence, one can divide reality in an empirical, actual, and real domain. The real domain distinguishes critical realism from other forms of realism: it consists of mechanisms and social phenomena which are not given in empirical data, and exist outside our knowledge of it. Concluding, critical realists always investigate both the empirical and real domain, suggesting the use of several theoretical approaches and methods.

Subscribing to a critical realist philosophy, I assume a reality that is structured, differentiated, stratified, and changing. Hence, I designed this study aiming to uncover the social phenomena that account for the gap between national regulations on irrigation and local irrigation

practices. Further, I assume that the use of both qualitative and quantitative methods is not a contradiction but helps to gain a holistic understanding, and likewise, the use of different theoretical approaches, namely mainstream and critical institutionalism. In accordance with the latter, I understand the human individual as norm-driven, acting according to what seems socially appropriate and not what purely maximises own utility. This is further reflected in the critical realist's assumption of mutual influence between the researcher and the transitive objects of science. Therefore, this study aimed to investigate empirical observations as well as underlying social structures and phenomena of irrigation management in Tanzania from a mainstream and a critical institutionalist perspective. Qualitative and quantitative methods were combined to investigate the underlying social phenomena of communal irrigation management while uncovering empirical relationships between irrigation and household income (Bryman 2012).

Population and Sampling

This study defined two populations: population one (P_1) of this study was defined as adult ($> 20 \text{ years} \leq 60 \text{ years}$) female and male farmers permanently living in the villages of Itunundu and Mboliboli, Iringa Rural district, Tanzania. Population two (P_2) was defined as female and male elders ($> 60 \text{ years}$) of the two villages as well as officials of Itunundu ward, Iringa Rural district council, and of the Rufiji Basin Water Office. P_1 was composed of 40 farmers from each village generated by a simple random sample from the whole village, as were the elders of P_2 ; four female and two male elders in Itunundu; three female and two male elders in Mboliboli. The rest of P_2 were chosen because they were part of a relevant institution involved in irrigation management in Iringa Rural district; four key informants, one focus group in each village.

Procedure and Time Frame

A month before the data collection, in September 2013, the two villages were visited by the professors and students of the research project. Thus, I was introduced to the village leaders and village executive officers, to the substitute of the District Agriculture and Livestock Development Officer at the Iringa Rural district office, and to the basin hydrologist of the Rufiji Basin Water Office. Purpose and course of data collection were explained and general information about the institutions was gathered. Further, the intakes of the traditional and semi-improved irrigation scheme were visited as well as parts of the canals. However, there

were no irrigation canals in use, since it was the end of the dry season, thus no farming and irrigation was taking place.

After getting introduction letters from Sokoine University of Agriculture in Morogoro and the District Executive Director in Iringa town, the data collection was carried out from 18th of October 2013 until 18th of November 2013 in the two villages as well as in Iringa town. For the three weeks of data collection in the villages, I was accompanied by a translator, because the majority of informants were only speaking Swahili. The first day of data collection was spent with pilot interviews and revision of the interview questions with help of the translator. From the second day on, 5-7 interviews were conducted daily, each one lasting for about an hour.

The informants were chosen following a simple random sampling. However, the villages were neither mapped nor were street names and house numbers existent, nor a list of names of inhabitants available. Thus, an inhabitant without official function in the village (hereafter referred to as 'village-guide') was chosen by the village leader who helped us find our way and introduced us to the informants. Each village is divided into sub-villages. Therefore, I divided the number of informants needed through the number of sub-villages, and randomly picked the informants accordingly as we were walking through each sub-village. The interviews were mostly conducted at the informants' homes since it was off-season and thus, the informants were only busy with daily chores but not actively farming. My translator then read the questions to the informants, explained them further if necessary, to then translate the answers. I was the one who wrote the answers down, respectively ticked off the particular box. If necessary, I asked additional questions and made notes on paper about my observations on informants' behaviour and characteristics of the household and home.

Instrumentation

The instrument to collect primary data from P₁ was a combination of a questionnaire and a semi-structured interview (hereafter referred to as 'HH-interview'). It included farmers' opinions as well as attitude scales, thus containing open-ended as well as closed questions. The HH-interview consisted of three sections: the first section concerned household demographics, the second section was structured according to the SLA, asking for assets used by the household to generate income, and the third section asked for the institutional characteristics related to irrigation management (see Appendix I).

However, not all questions were answered in a ‘good’ way. For example, respondents had difficulties to give clear answers to questions regarding households’ relationships to institutions such as water user association and River Basin authorities (see question A10, Appendix I). They were either not conscious of the existence of the institution, or associated them with different but related institutions; River Basin authorities were also associated with the hydropower supply company TANESCO or with the police who helped to carry out the monitoring of irrigation systems. Moreover, questions regarding rules for water access and use were sometimes not understood (see questions C4, C6, Appendix I). In both cases, we tried to clarify and discuss with respondents to come up with reasonable answers.

The instruments to collect primary data from P₂ were focus group discussions and semi-structured interviews with guiding topics and some open-ended key questions (Appendix II). The focus group discussions were held with members from the village irrigation committee and concerned history, regulations, and management of the irrigation schemes. The semi-structured interviews with the elders concerned history, ethnicity, and agricultural practices in the villages. Both were conducted together with the translator in Swahili whereas the interviews with key informants of official institutions were conducted by me in English. These key informant interviews concerned procedures and regulations around water permits, scheme development, and cooperation with communities. In addition, one general village meeting in each village was observed to take notes on election procedures, power relations, and gender. The rest of the data was secondary data collected from peer-reviewed articles, government and NGO documents and reports.

Analysis Plan

For the institutional analysis across levels as well as on village level, the framework for analysing natural resource regimes was applied. Current political actors, the different types of institutions as well as the relations between the institutions were described and their responsibilities compared to what is written in the National Water Policy (NAWAPO). Further, current informal institutions were uncovered and compared to the institutional characteristics as discussed within MI and CI (see Table 1). On household level, descriptive statistics as well as tests to compare means were applied to test for random distribution and to display whether socio-economic factors significantly differ between the levels of the response variable, using the statistical program JMP 11.0 (*JMP®*, Version 11. 1989-2007). Response variable were villages, irrigation schemes, and wealth groups. Wealth groups were divided

according to the net HH income. The farmers within the first 33 percent represent the lowest income group; farmers within the second 33 percent represent the middle income group; farmers within the last 33 percent represent the highest income group.

The following *socio-economic factors* were tested on random distribution against the response variables: share of male HH-heads (%), age HH head, share of married HH-heads (%), share of primary education and no formal education of the HH-head (%), HH-size, share of farmers with sufficient income (%), share of HHs which were less well-off compared to five years ago (%), share of farmers owning a power tiller (%), share of farmers who took a loan (%), land owned (acre), land rented (acre), livestock owned (%), number of unpaid labour received, and the mean Net HH income per year (Equation 1).

To quantify HHs' activities, income shares were calculated in relation to total gross income (section 5.3.2), which equals the calculation of the net income but excludes the costs.

Equation (1): Net household income

$$Y_n = \sum_i^n [(I_{nonfarm+onfarm+forest}) - (C_{area\ rented+inputs+water+labour})]$$

Where:

Y_n = Net income,

$I_{nonfarm}$ = Income from non-farm activities
(petty business and land let)

I_{onfarm} = Income from farming activities
(kg paddy harvested x price sold +
livestock sold)

I_{forest} = Income from forest (firewood)

$C_{area\ rented}$ = Rent paid for agricultural
land

C_{inputs} = Machines rented for land
preparation + fertilizer, hybrid seeds &
pesticides used

C_{labour} = Wages paid to hired labour

Tests used

Each nominal variable characterizing the HH, usually presented in percent, was tested separately from the other variables with *Pearson's Chi-Square* test or with *Fisher's Exact Test* on whether significant differences exist between the different levels of the nominal response variable (wealth groups, villages, irrigation schemes). Each continual variable characterizing the HH was tested with the *Tukey-Kramer HSD* test on whether their means

display significant differences between the levels of the tested nominal response variable (wealth groups, villages, irrigation schemes).

Reliability, Validity, Representativity

Reliability concerns the consistency of a measure of a concept. In case of this study, we look at reliability in terms of stability as a measure for consistency over time and inter-observer consistency as a measure of consistent decision-making, for example, when categorizing answers (Bryman 2012; p. 169). In terms of stability, the results are not very reliable since they are derived from peoples' perceptions which are subjective and relational and most likely subject to change over time. Yet, in terms of inter-observer consistency, the results are relatively consistent since all data was collected, categorized, and analysed by the same person and with help of the same translator. Still, there is a certain level of unavoidable inconsistency due to subjectivity of both the translator and the researcher. However, all was done to keep it as low as possible.

Validity refers to the reliability of the conclusions we draw from our findings and thus, if the indicators which are supposed to measure a concept really measure that concept (Bryman 2012). In the study's case, validity concerns 'measurement validity' and 'external validity' as defined by Bryman (2012). Thus, measurement validity refers to the measure of HHs' livelihoods in general, and HHs' income strategies in particular by using the sustainable livelihoods approach (SLA) (Ellis 2000a). Being applied in several case studies, such as by Kamanga et al. (2009), Paavola (2008), Tumusiime et al. (2011), Tsegaye et al. (2013) and Vedeld et al. (2012), we can be confident that the indicators as suggested by the SLA, such as the socio-economic factors of a HH and the HHs activities, also measure the livelihood of a HH. External validity relates to whether the findings can be generalized beyond the present study area and thus, relates to the sampling method. In case of this study, population P_1 was randomly sampled in both villages; thus findings should represent the entire village population. Yet, with regards to the two irrigation schemes, the sample sizes were different. For Mlinge semi-improved scheme, the sample size was with 21 farmers rather small and is thus not necessarily representative for the whole scheme. Yet, findings derived from the entire population P_1 , are relatively valid and may also apply to other villages in the ward.

Moreover, we shall look at how representative the findings of this study are. Comparing agricultural characteristics in the study area with average measures in the district, the study area, productivity of paddy cultivation per hectare was lower, whereas the planted area of

paddy per HH was higher than in the district. However, the study area is very representative in its dependency on irrigation; both in district and study area most HHs rely on irrigation farming. Yet, in the district, crop marketing is not a problem, while it is one of the main problems in the study area. Further, the census reported that access to credits is very low in the district; only 2.6 percent accessed credits. In contrast, in the study area, 50 percent of the HHs accessed credits (Agricultural Census Iringa Region 2012). Thus, findings cannot be generalized; yet, they can serve as comparison for studies from similar climatic areas and populations who mainly rely on one irrigated crop. Further, the study area is characterized by high competition over water due to the hydropower plant downstream. This may reduce representativeness for the district but may serve as a comparison for other case studies which are located around hydropower plants.

Limitations

Case studies are inherently limited since the findings are highly contextual. Thus, some findings may be difficult to generalize or replicate, and may be highly subjective. Indeed, derived from an area characterized by semi-arid climate, scarce water resources and strong competitors, the findings may not explain issues of water governance in general. However, they may serve as guidance and example for areas facing similar ecological, economical and social challenges. Besides these context specific limitations, findings derived from primary data are inherently subjective and may change over time. Thus, maximising triangulation of informants' statements with results of the quantitative analysis of the HHs according to wealth groups, villages and irrigation schemes, as well as with information from secondary data and theory should minimize subjectivity.

Moreover, informants' perception of the village-guides, the translator, and me may have altered informants' behaviour and statements. In general, respondents in the two villages were very cooperative, although it was easier to talk to women in Itunundu village than in Mboliboli village. This said, the village-guides may have had the biggest influence because they were known by some of the respondents. On the one hand, a guide from the village gives trust and helps to get in touch with the respondents. On the other hand, village-internal power relations may come into play when respondents and guides know each other. Depending on the relationship between them, respondents are more confident or more hesitant. In Itunundu village, our guide was a 31-year old single woman with three kids. She did not hold an official position in the village but was self-confident, even raising her voice as the only

woman in the general village meeting. Thus, although she merely introduced us, her presence and the fact that she is a woman may have influenced respondents, especially female ones.

In Mboliboli village, our guide was a married man around the same age with two kids, also not holding an official position in the village. It is difficult to say if the fact that we had a male guide influenced the behaviour of the respondents, or stricter 'gender-roles' in general. However, we had to ask the husband's permission in order to talk to their wife; the respective husband often attended the interview, or was taking over the interview at some point.

Further, these statements were influenced by the translation process; some information was most probably lost, some information slightly altered by the understanding, perception, or opinion of the translator. Thus, it will be difficult to exactly replicate the findings. However, to compensate for this limitation, the population, sampling, instrumentation, and procedures were outlined precisely above.

Besides, when asking farmers about their perception of fairness water distribution during scarcity, I did not clarify my understanding of fairness. Thus, some farmers answered that it rather depends on the location of the farm or they argued that there is no irrigation during water scarcity. Further, I asked about the fairness of access rules, but I did not specifically ask about farmers' perception of fairness regarding use-rules, costs and benefits of irrigation. This made the institutional analysis more difficult and vague.

Moreover, the sustainable livelihoods analysis has some limitations regarding the evaluation of the impact of irrigation on farmers' income. Results displayed that in both sampled villages the majority has access to irrigation; only one interviewed farmer had no access because he was landless. Thus, there was no possibility to compare HHs' income with and without irrigation. Hence, this limits the validity of the data to show the effect of irrigation on HHs' income and how changing of irrigation institutions effect HHs' income.

Ethics

Following Bryman (2012), ethics in social research concern harm avoidance, informed consent, respect for privacy, and transparency of the research process. The research process as well as the presentation of findings and data storage should neither physically harm participants nor their development or reputation. Hence, I did my best in respecting these principles while designing, conducting and presenting this study. Further, harm avoidance

also means to inform participants about who is conducting the research, the content of it, how their data will be used, and that participation is voluntary and can be refused at any time. Thus, before every interview participants were instructed through an orally informed consent. Similarly, participants were informed about their anonymity and the confidential storage of their data to comply with the principle of respect for privacy. Thus, neither names of participants in the villages were written down nor the sub-village they reside in. The names of the government officials were recorded with their agreement, but not displayed in the findings. Finally, the study was only presented as what it is and as nothing else, complying with the principle of transparency.

5 Results and Discussion

This chapter presents the results of the analysis of communal irrigation systems on different government levels in Iringa Rural district. Following the three objectives of this study, I will answer the research questions accordingly, aiming to discover what accounts for the gap between national regulations on irrigation and local irrigation practices.

5.1 Interlinking of Institutions across Government Levels

Before looking at the institutions of communal irrigation management in the villages, we need to understand the broader framework of water governance. Therefore, the resource attributes, the infrastructure in place, and the formal institutions of water governance are investigated as well as how they interlink district and village level. More specifically, the following section focuses on resource allocation, resource attributes and infrastructure; and political actors and institutions (Fig. 1, section 3.1).

5.1.1 Allocation and Attributes of Water and Irrigation Infrastructure

RQ 1: How is water in the Great Ruaha river basin allocated between the domestic, environmental, and economic sector? And what are the attributes of the Little Ruaha river?

In Tanzania, water belongs to the state and every citizen has the equal right to access and use the country's water resources for his and the nation's benefit (NAWAPO 2002). However, water allocation between different sectors follows priorities set by the National Water Policy (NAWAPO) of 2002 and the Water Resources Management (WRM) Act of 2009 (NAWAPO 2002; WRM Act No 11 2009). Based on the policy guidelines, the Basin Offices prioritize first, water for drinking and sanitation, second, water for the environment to protect the ecosystems underpinning the water resources, and third, water for other uses, such as irrigation or hydropower generation. While prioritising water for basic human needs and the environment is mostly undisputed, whether to prioritise water for hydropower generation or irrigation is contested.

Thus, water for 'other uses' require water use permits which specify for how long and how much water the users are allowed to extract. The respective Basin Office, together with the

district office, examines the amount of water needed for hydropower or irrigation and its availability. The Central Water Board then decides whether to approve the water use permits and the Basin Offices grant them (NAWAPO 2002; personal interview with RBWO staff, 11/18/2013). The NAWAPO requires the Basin Offices to follow the polluter-pays and the user-pays principles, thus, charge water users for these permits. These principles suggest that fees lead to more efficient water use and distribution in irrigation schemes: conserve water, increase its quality, and eventually ensure sustainability. Further, they suggest that fees raise awareness among water users that water is an 'economic good' and not a 'gift from God' (WRM Act No 11 2009; personal interview with RBWO staff, 11/18/2013). Yet, water users in the villages and especially elderly respondents repeatedly mentioned water and land resources in fact as 'gifts from God' (personal interview, 11/13/2013).

Hence, despite farmers have been paying water use fees since the early 2000s, there is still a lack of understanding of the need for it. This suggests that merely introducing such formal institutions does not automatically change farmers' rational water use and irrigation practice. In the villages, they rather increase inequalities and add issues of corruption. Thus, this lack of understanding not only influences farmer's irrigation practices but also challenges the formalization of the irrigation regime.

Besides, the allocation of permits for 'other uses', such as hydropower and irrigation, is 'subject to social and economic criteria' (NAWAPO 2002). These criteria are not further specified by the NAWAPO. However, the WRM Act of 2009 mentions a provision on payments for environmental services (PES), but does not provide practical guidelines for permit allocation (WRM Act No 11 2009). In theory, the RBWO has the authority to assign the hydropower company downstream to compensate the affected villages upstream for using less water; for example by supplying them with electricity. However, in the study area, efforts to introduce compensation payments, such as PES, did not go beyond the level of feasibility studies (Fisher et al. 2010). Thus, there is a lack of clear criteria for the allocation of permits between hydropower and irrigation and for institutionalized procedures for compensation. This becomes critical in an area such as the Great Ruaha basin, where water is physically scarce and the hydropower company needs 40 percent of the available water and the domestic and agricultural sector the remaining 60 percent (interview with RBWO staff, Iringa; 09/25/2013).

This lack of clear allocation criteria facilitates the prioritization of hydropower over irrigation and thus, challenges fair water allocation. The Little Ruaha River only provides sufficient amounts of water for irrigation and hydropower generation during the rainy season. Thus, there is physical water scarcity during the dry season and high competition during the rainy season. Both cause an allocation-conflict between irrigating farmers upstream and a hydropower company downstream. Indeed, the RBWO argues according to its economic rationality: “you cannot allow [farmers upstream] to irrigate twice a year and half of the country is going dark [due to a lack of water for the hydropower plant downstream]” (personal interview with RBWO staff, 11/18/2013). Thus, in the study area, the RBWO restricts farmers’ irrigation period to the rainy season in order to ensure sufficient water flow for the hydropower plant during the dry season and without effecting compensation for the farmers. Hence, the basin development is non-linear and water re-allocation is influenced by power relations and economic inequalities among the users; this is also discussed by Molle (2003).

However, farmers’ perceptions indicate that they are well aware of this physical water scarcity and of the lack of compensation for restricted water use. Regardless of which scheme farmers use, about 40 percent state that they do not get enough water to irrigate their fields (own data). Similarly, 30 percent of all respondents state that they have a bad relationship with the hydropower company: 46 percent of these blame a lack of compensation for restrictions on water use (own data). Concluding, regulative weaknesses not only lead to allocation conflicts but also to political and economic exclusion of farmers.

RQ 2: What kind of infrastructure is in place to distribute water from the river to the farms?

On top of these regulative and political issues, farmers in the study area are further challenged by poor irrigation infrastructure. The water intakes of the irrigation schemes and the location of the farms physically restrict the water use. The physical restrictions on water use differ depending on the construction of the water intake. The intake for Mlenge scheme is ‘semi-improved’: a constructed weir with a gate which can be properly opened and closed followed by two kilometres of constructed main canal. Thus, farmers can regulate water flows, and the RBWO can measure time and amount of water extracted as well as close the water intake during the dry season. On the other hand, the intake for Mkombozi scheme is ‘traditional’, built of sandbags, rocks, and branches on the village land of Itunundu. Here, farmers are unable to regulate the water flow, especially during high flows. Thus, the RBWO can neither

exactly measure time and amount of water extraction nor close the water intake completely. Moreover, in both schemes, canals for further water distribution to the farms are hand-dug and need to be yearly rebuilt by the farmers.

Similarly, farmers' statements reflect the difference between the two irrigation *intakes* and the general lack of infrastructure: for 48 percent of the farmers (26 farmers out of 54) using the traditional scheme (hereafter referred to as 'Mkombozi-TS') and for 29 percent of the farmers (6 farmers out of 21) using the semi-improved scheme (hereafter referred to as 'Mlenge-IS') poor irrigation infrastructure is a main farming challenge. Thus, in addition to the physical scarcity during the dry season and high competition, a lack of irrigation infrastructure leaves farmers with too little water or flooded farms during the rainy season.

5.1.2 Political Actors and Different Types of Institutions

Besides the physical restrictions, the villages also face institutional restrictions on water use. Indeed, the whole water sector slowly undergoes a process of reformation and formalization. Part of this process is the permit allocation and its regulative and political weaknesses, we already touched upon. However, besides the RBWO and the hydropower company, there are more actors and institutions involved in this formalization process. Thus, to get a more holistic understanding of communal irrigation management, the next section identifies the responsibilities of the political actors and institutions. More specifically, how actors relate to the institutions which govern the policy processes and the irrigation regime itself (Fig.1, section 3.1).

RQ 3: Who are the political actors defining the irrigation regime and policy processes for irrigation management in Iringa Rural District? And according to what types of institutions do they act?

The country's water policy lays the institutional foundation for the formalization of the two irrigation regimes (NAWAPO 2002; WRM Act No 11 2009). However, from basin to village level, several other formal and informal institutions and actors govern the formalization of the access and interaction rules for irrigation in the two schemes. More specifically, six main political actors are involved in this formalization process. From the highest to the lowest government level these are: first, the mentioned Rufiji Basin Water Office (RBWO) in Iringa Town, second, the Zonal Irrigation Unit (ZIU) in Mbeya, third, the

Iringa Rural district council (DC) in Iringa Town, fourth, the ward agricultural extension officer (WAO), fifth, the irrigators' organisations (IOs), and sixth, the village councils, respectively their committees for irrigation management and development (IC).

The RBWO, part of the Ministry of Water, is one of the key political actors, allocating water to two studied irrigation schemes. Yet, besides the RBWO, several sub-offices and formal institutions are missing in the Rufiji basin. Thus, there are staffing and institutional gaps at the catchment level which are filled with informal institutions. However, the Rufiji River basin covers 20 percent of the country's total area and has several different water users (Maganga 2003). Thus, the basin is further divided into sub-basins and catchments. The studied schemes lie in the Little Ruaha river catchment, which is part of the Great Ruaha river basin. Due to the size of the basin, the country's water policy suggests that each sub-basin has a sub-office to supervise the different water users. The different water users of a catchment, such as irrigators' organisations (IOs), hydropower companies, and National Parks should then unite in water user associations (WUAs). WUAs should implement a constitution according to the needs of the catchment and its users. Yet, there are no existing sub-offices and institutions in the Little Ruaha river catchment. Thus, the RBWO interacts directly with the IOs of the irrigation schemes in the studied area, governed only by the country's water policy, which apply to the whole basin (NAWAPO 2002; WRM Act No 11 2009).

For the RBWO, the water policy has two related functions: governing the policy processes for irrigation, and with that, defining the irrigation regimes on village level. As institutions governing the policy processes, the water policy assigns the responsibilities of the RBWO, such as management, monitoring, development, and allocation of water resources between the domestic, environmental, and economic sectors. As institutions governing the irrigation regime the water policy enables the RBWO to define the formal access and interaction rules for the use of irrigation-water in the studied schemes. These are the mentioned water use permits and formal interaction rules. Permits define opening and closing times for the scheme intakes as well as the amount of water farmers are allowed to extract from the river. For both schemes, opening times are from December until July with a water permit to extract a certain amount of water per day. However, unlike Mlengi-IS, in Mkombozi-TS the RBWO cannot fully control amount and time of water extraction. Therefore, Mkombozi-TS has only a conditional water permit until the intake is constructed. The formal interaction rules include

monitoring compliance with the rules, solving conflicts, imposing sanctions if necessary, and charging fees from farmers for water use.

The water use fees are mainly used to run the RBWO, whereas as monitoring should improve scheme management and thus, benefit the farmers. With paying water fees to the RBWO, the farmers as economic actors become typical resources providers for political actors such as the RBWO; see also section 3.1. More specifically, this means that IO of Mlengi-IS pays 3,7mill TSh to the RBWO for a water use permit, and IO Mkombozi-TS 2,7mill TSh. Yet, due to the lack of sub-offices and institutions, RBWO staffs only collect fees from the IOs without sharing any visible benefits in form of improved irrigation infrastructure, for example. Indeed, when the village irrigation committees were asked (ICs) about the benefits they get from RBWO, the common answers were: “none at all! They just come and collect the money” (personal interview with IC Itunundu & IC Mboliboli, 10/30/2013; 11/11/2013).

Monitoring is done through analysing water flow and meteorological data, and together with the police through the so called ‘control and regulation exercise’. According to RBWO staff, ‘control and regulation exercise’ means that they “[...] go with the police and catch those people who use water illegally or abstract more water than allowed”. Thus, at village level, the RBWO has either no reputation due to a lack of presence or a bad one. Indeed, 26 percent of the farmers (21 out of 80) stated that they have no relation to or do not know about the RBWO. Moreover, farmers lump the RBWO together with their strongest competitor, the hydropower company, or the police. Thus, the RBWO lacks resources to fulfil their responsibilities in the whole basin, and draws on other state-actors to support the implementation of the formal interaction rules.

However, the RBWO is not the only political actor who defines the resource regime. At the regional level, the RBWO’s areas of responsibility overlap with the Zonal Irrigation Unit (ZIU) and the Iringa Rural District Council (DC). ZIU belongs to the irrigation section of the Ministry of Agriculture. It operates according to the agro-ecological zones and is thus the overall supervisor of irrigation in the Southern Highlands Zone, which includes the study area. The DC is a sub-council of the Prime Minister’s Office and divided into three units: agricultural office, irrigation office, and corporative office. It is further explicitly mentioned in the NAWAPO of 2002 as a fully participating member in water resources planning on basin and catchment level.

Thus, the ZIU and the irrigation office of the DC both influence the resource regime: by giving agricultural advice and organising trainings, such as for rice intensification programmes, by giving technological and financial support for irrigation scheme development, and by making final decisions over the location of new intakes. Thus, by deciding where and how an intake is built, they physically determine water access, while by influencing the farming techniques they change the institutions of water use. In the study area, the intake of Mlenge-IS was constructed by the government with help of the villagers in 1992, before the current institutions were in place. Thus, it is difficult to identify the specific actors and institutions involved in constructing the intake. However, ZIU and DC were involved in the formalization of the resource regime since 2005: first, with the physical improvement of Mlenge-IS intake, and afterwards with facilitating permit applications and defining the access and interaction rules for irrigation in the village constitutions.

Yet, DC and ZIU only have weak criteria for scheme development; they rather resemble rules of thumb. One criterion is the DC's and ZIU's financial budget; a second one is the priorities for village development set by the village councils, and a third one the number of farmers who benefit from an improved scheme. However, decisions are mainly based on informal discussions among DC, ZIU, WAO, and village councils. In the study's case, the DC and ZIU, together with the WAO, decided to improve Mlenge-IS. Firstly, because improving Mlenge-IS intake was cheaper than building a new intake for Mkombozi-TS. Secondly, Mlenge-IS has more beneficiaries than Mkombozi-TS (personal interviews, 11/04/2013; 11/12/2013). Thus, a lack of criteria allows power relations among the different actors to determine scheme development and exclude farmers who rely on smaller irrigation schemes.

Similarly, power relations among DC, ZIU, and village councils determine the definition of the irrigation regime on village level. For example, when formalizing the village constitutions in order to create official access and interaction rules for irrigation management. According to DC staff, for Itunundu village, the formalization process of the village constitution was as follows: the village council, the corporative and the community development officer of the DC, and an irrigation agronomist from ZIU built a committee to discuss potential rules for the irrigation management in the villages. The committee members from the DC formulated the rules for irrigation management. They further proposed a model of the constitution to the village council who could then decide which paragraphs should be included in the final

version of the village constitution. Eventually, the latter was sent to the Ministry of Home Affairs for official registration.

Indeed, it is to question if the village council could freely decide on the final version of the constitution, or if the DC and ZIU rather dictated what they had to include in the constitution. On the other hand, it is to question, if the village council respects and also represents the villagers' opinions and needs of irrigation management. However, data shows that farmers do not feel involved in the rule-making process. Namely, 82 percent (14 out of 17) of farmers using Mlengi-IS and 73 percent (27 out of 37) of the ones using Mkombozi-TS state that village council, IC, or DC are making the rules for irrigation (own data). Thus, although perceived as rather distant actors, the DC and the ZIU have been shaping the formal irrigation regime in the villages. Yet, it is difficult to determine which of the institutions they precisely influenced in irrigation management in the villages.

Moreover, the Ward Agricultural Officer (WAO) is another political actor closely linked to DC and ZIU. The WAO links the DC with the villages of Itunundu ward and thus, with the two schemes. Together with the DC and the ZIU, he is responsible for agricultural development in the ward: education on and introduction of modern agricultural practices and technologies, efficient water use, and irrigation scheme development using the concept of farmer field schools. Last cropping season (2012/2013), farmers from Itunundu ward were part of trainings on farm levelling, rice seed and seedling selection (personal interview with the WAO, 11/12/2013). Moreover, the WAO has to solve conflicts over water use, officially according to the constitutions of the IOs. Thus, the WAO shapes the interaction rules for communal irrigation directly when solving conflicts, and indirectly when possibly changing farmers' behaviour through education on efficient water use. However, he reports that the main challenge is the lack of formal by-laws, although they exist. This indicates that on village level often neither farmers nor government officials are aware of the irrigators' organisations (IOs) or implement their formal institutions.

Taking a closer look at the IOs of the two irrigation schemes, they are registered with their own constitutions at the Ministry of Home Affairs since 2005 and 2013 respectively. Despite the differing water intakes of Mkombozi-TS and Mlengi-IS (see section 5.1.1 for more detailed information), their formal management and institutions – the constitutions of the IOs – are rather similar. According to the IO-constitutions, every farmer who owns or rents irrigated land in either of the schemes is supposed to be a member of the respective IO. Thus,

farmers have certain duties such as cultivating every year, paying a one-time entrance fee (10,000 TSh), as well as a seasonal fee (5% of their harvest/acre), and a water use fee (10,000 TSh/acre/year). In return, farmers have the rights to use water according to the regulations, attend the meetings, and to vote and be voted for the boards of the IO. If they do not comply with the sanctions, they are fined; for example 150,000 TSh for blocking a canal plus possible costs of removal.

Moreover, the constitutions define the formation and assign responsibilities of the IO boards. Thus, the IO boards consist of representatives from each village which is served by the particular scheme. For example, Mkombozi-TS serves the two villages and a prison; hence, it consists of the respective people from Mboliboli and Itunundu village, and representatives from the prison. Moreover, the IO boards collect the mentioned fees and pass a certain amount of the water use fee on to the RBWO for the granted water permit. Further, they are to supervise all irrigation activities, including maintenance of infrastructure, organising and implementing the cropping calendar, regular monitoring and ensuring compliance with the rules, imposing defined sanctions, and solving conflicts over water use. Thus, formal access and interaction rules are clearly defined, both in Mkombozi-TS and Mlenge-IS. However, these formal institutions are not fully implemented and are thus, replaced and supplemented by informal institutions. A more detailed discussion of these informal institutions and potential differences between the two irrigation schemes will follow as part of the second objective.

Yet, according to my impression, one of the reasons why farmers do not fully implement the IO-institutions is a lack of knowledge of the IOs. Hence, IO-institutions are not socially embedded in farmers' daily activities and thus, implemented. When asking 15 farmers about their relation to IOs or WUAs, regardless of the scheme they used, 13 stated that they do not know about either of them. Thus, this question was changed and farmers were asked about their relation to the ICs instead. However, in Mboliboli village, some farmers knew about the IO Mkombozi-TS, but stated that it was new and the constitution has not been implemented; only two out of 54 farmers were members of IO Mkombozi-TS. Yet, this comes as no surprise since the IO was registered only seven months before farmers were asked. Yet, none of the interviewed farmers was a member of the IO Mlenge-IS, although it was registered in 2005. The rather small sample size may have contributed to this (24 farmers out of 5,000); however,

it indicates that farmers do not perceive IOs as actors or only as rather distant actors and thus, do not fully adopt the IO-institutions.

Since the irrigation schemes reach up to 40km and serve up to seven villages, each village has an irrigation committee (IC). The IC is part of the village council and carries out the daily irrigation management. Thus, the majority of farmers know about the ICs, as opposed to the IOs. The IC consists of the village chair person and of farmers who are members of the respective IO. Thus, some village IC members are at the same time members of the IO board. In Itunundu village, where farmers use both schemes, the village IC consists of farmers from the IO board of Mkombozi-TS and Mlenge-IS as well as of ordinary IO members. Indeed, one would expect the village IC to be a delegation of the IO, governed by the IO-constitution. Yet, the village ICs have their own constitutions which assign their responsibilities. These responsibilities are similar to the ones of the IOs, but limited to the particular village land. Thus, the ICs are independent political actors and representatives of the IOs at the same time. In Itunundu village, this leads to contradictions: the IC-constitution has different rules for the IC-election than the IO-constitution of Mkombozi-TS; however, these contradictions will be further discussed in section 5.2.4.

Summing up, in the study area, water governance still undergoes transitions from informal to formal structures, creating institutional gaps and overlaps and causing allocation and management challenges. At regional level, lacking criteria challenge water allocation between hydropower and irrigation as well as scheme development. The lack of clear criteria facilitates the prioritization of hydropower over irrigation and thus, excludes farmers from irrigation during the dry season and increases competition during the rainy season. If competition is high, also social inequalities increase and marginalise the poorer and less powerful farmers. Staffing and institutional gaps at sub-basin and catchment levels challenge cost and benefit sharing between the RBWO and the DC on the one hand and the farmers on the other hand. The RBWO increases the costs of the farmers by restricting their water use for irrigation through introduction of formal institutions. However, farmers do not get any benefits: neither led formal institutions to more equal or efficient irrigation management, nor is the DC able to improve irrigation infrastructure or regularly provide farmers with agricultural advice and trainings (personal interview with DC staff, 11/06/2013). Thus, the RBWO manages water for irrigation according to general institutions such as the water policy, but not together with the different users of the Little Ruaha catchment and according to their needs.

Thus, on village level, poor irrigation infrastructure, insufficient financial resources, and institutional gaps leave farmers with restrictive but incomplete and contradicting formal institutions. The alteration of the existing informal institutions which govern irrigation, allows community-internal power relations to come into play. In Itunundu village for example, this allows to exclude farm renters from participating in irrigation management, while giving more power to farm owners. Thus, such institutions rather increase local inequalities instead of making irrigation management more democratic and fair.

These inequalities are reinforced by poor irrigation infrastructure of the two schemes. Poor irrigation infrastructure adds to competition and conflicts, because regulating water flows and distribution becomes difficult: conflicts arise because some farmers have to block canals in order to get water while others' farms flood. Moreover, poor irrigation infrastructure causes challenges for future irrigation development: no or insufficient data on water availability threatens environmental flows of the river and potentially leads to water over-use. On regional levels, it leads the DC and ZIU to plan and build schemes for water that is not available. In addition, the lack of clear criteria for scheme development allows power relations among village councils, DC, and ZIU to determine the improvement of schemes and excludes farmers whose schemes benefit only a few, such as Mkombozi-TS.

Concluding, the formalization of the irrigation regime follows a top-down approach governed by the RBWO and new introduced formal institutions. Yet, there is a lack of staff and formal institutions on sub-basin and catchment level. Thus, new institutions reach the village level only partly. Accordingly, the irrigation regime undergoes changes and hence, consists of new and 'old' institutions. These changes reinforce scheme-internal power relations which alter informal institutions and thus, daily irrigation management as well as scheme development. Thus, in order to better understand the 'institutional bricolage' of irrigation regimes, we shall take on a bottom-up approach and look at institutional characteristics and how farmers perceive these.

5.2 Formal and Informal Irrigation Institutions

Having examined the broader water governance structures in Iringa rural district, it becomes clear that the top-down formalization process of the irrigation regime is still under way and is incomplete. The sub-basin and catchment levels are littered with staffing and institutional

gaps, and new institutions only partly reach the village level. Thus, the current irrigation regimes consist of a mix of formal and informal institutions. Taking a bottom-up approach, this section investigates how the formalization processes affect the two irrigation schemes. More specifically, it examines the characteristics of the formal and informal institutions governing irrigation, and how farmers perceive these institutions. The theoretical discussion of the mainstream and critical institutionalist perspectives (see section 3.2) will structure and guide the discussion of the irrigation regime.

RQ 4: Following the different views of MI and CI, which characteristics apply to the current institutions governing irrigation in the two schemes and how do they differ between the two schemes?

5.2.1 Community, farm, and resource boundaries; access and use rules

According to mainstream institutionalists, clear boundaries as well as access and use rules facilitate communal irrigation management: reduce transaction costs, such as for organisation and information; and maximise benefits, such as cooperation, trust, and reciprocity. However, critical institutionalists argue that community, farm, and resource boundaries are seasonal and fuzzy. Besides that, farmers also draw on extended social and cultural networks to access water. Thus, the boundaries and rules are rather difficult to define and stricter and clearer rules do not necessarily reduce costs of management and human cooperation. In this study, most of the farmers perceive boundaries of farms and access rules to the river as clear. However, this does not imply that boundaries and rules are stable and, as Ostrom (2008) suggests, that farmers always know about and follow these boundaries and access rules. Rather, as Cleaver and Franks (2005) suggest, some rules are rather fuzzy and change, depending on the season and community-internal power relations. Further, as Cleaver (2012) suggests, they reinforce social inequalities and reduce costs only for rather wealthier farmers but not for the poorer farmers.

Mlenge semi-improved scheme

In Mlenge-IS, farmers perceive resource and farm boundaries as clear; however, in practice, some farmers question boundaries and use the resource illegally. The resource for Mlenge-IS is the Little Ruaha River, used for irrigation during the rainy season. The community using Mlenge-IS consists of farmers who rent or own irrigated farm land which belongs to Itunundu and six other villages. In theory, every farmer should be a member of this community, that is,

the IO Mlengi-IS. However, this is not the case; as mentioned in section 5.1.2, the IO Mlengi-IS is perceived as an artificial and administrative community. The formal boundaries of this artificial community do not fit the perceptions of the members of the existing social community: in the study's case, the villagers of Itunundu. Thus, in practice, the boundaries remain empty shells and farmers rather draw on existing institutions to define community boundaries: any farmer who owns or rents land in the area gets water. This follows the expectations of critical institutionalists such as Cleaver (2012). Farmers mark their farm boundaries with trees, rocks, and sand dams or piles. Yet, this does not seem very precise, but all of the interviewed farmers (20) using Mlengi-IS stated that the farm boundaries are clear and known, defined by the farmers themselves. However, three people reported to have had a land conflict within the last five years, indicating that boundaries, although clear, remain contentious.

The formal water access rules for IO Mlengi-IS are clear and known: the IO Mlengi-IS officially holds a water use permit from the RBWO to access water from the Little Ruaha River. Hence, they are allowed to extract a daily amount of 345.600,00 m³ of water from the river for irrigation from December to July (RBWO staff, 11/18/2013). Members of the IO board open and close the gate of the weir in behalf of the RBWO to start and end irrigation; the RBWO staffs recheck if the gate is properly closed. Thus, access rules are not made by the community, and hence, do not increase trust and reciprocity among its members, as suggested by Ostrom (1990). This may lead to more conflicts among farmers and thus, to even less fair water access and distribution.

In contrast to the access rules, the rules of use are not perceived as clear. As mentioned earlier, although the IO-constitution and its official rules have existed since 2005, most of the interviewed farmers (13 out of 15) using Mlengi-IS did not know about it. Thus, farmers perceive water use-rules still as norms of good conduct and the appropriate way to act, rather than as formal rules made by the IO. The common norms also involve inspecting and cleaning the canal before irrigating, and closing the canal when the farm has enough water. When asked about the rules, 75 percent of farmers (15 out of 20) state that the water-use rules are clear. Still, 25 percent of farmers state that the rules are not clear. Indeed, the IC Itunundu has no regulations for how long and how much water a farmer is allowed to extract. Farmers just take as much water as they need which depends on size, location, and relief of their farm (personal interview with IC Itunundu, 10/30/2013).

Thus, neighbouring farmers have informal rules for water use, especially in times of scarcity. The majority of farmers (75%) have agreements with their neighbouring farmers to ensure that everyone gets enough water. For example, if a farmer has difficulties getting water, she or he agrees with the neighbouring farmers to block a canal in order to get water for their farm. If that farmer gets enough water, the canal is opened again and the water continues flowing to the neighbouring farms. Other farmers describe it as a rotational system: one farmer uses water during the day and the other one during the night. However, these informal use rules are clear for the community of neighbouring farmers who make these rules. Thus, as suggested by Ostrom (2008), these clearly defined rules appear to increase trust and reciprocity among them and thus increase cooperation. However, these findings only seem to hold for the lowest level of a community: a group of close-neighbours.

Yet, moving back to the ‘scheme-community’ level, five farmers (25%) stated that these informal rules lead to conflicts over water use. On the one hand, this indicates that some farmers see each other as rather anonymous competitors over water, supporting the mainstream institutionalists’ perspective. For example, some farmers stated that conflicts arose, because all farmers needed water at the same time, and indicated that they were not willing to cooperate. Thus, they are the free-riders of a community due to unclear and non-formal use-rules and unenforced sanctions (Ostrom 2008). On the other hand, it is also possible that farmers are willing to cooperate but do not have the social capacity to do so, because rules reinforce inequalities, as argued by critical institutionalists. For example, a female farmer, belonging to the low-income group, stated: “my neighbours don’t share. They will never give you water” (respondent no. 33, Itunundu village, 10/27/2013). Thus, the woman may have been willing to cooperate, but was not able to convince her neighbours to do the same, due to little social capacity, such as being a woman or being poor. This shows that socially embedded informal rules reinforce existing inequalities, influenced by gender and economic status, and further exclude the poor, as stated by Cleaver (2012). Thus, whether farmers have conflicts over water use depends on farmers’ personal willingness and social capacity to cooperate.

Mkombozi traditional scheme

In Mkombozi-TS, resource boundaries, ownership of the scheme, and some village lands and farm boundaries are unclear. Mkombozi-TS has the same water resource as Mlenge-IS: the little Ruaha River. However, although farmers perceive resource boundaries as clear, they are

not clear due to the unconstructed intake. More or less water than allocated through the water permit may flow into the scheme. Further, the Mkombozi-TS community is much smaller. It consists only of a prison with circa 50 prisoners, and the farmers who rent or own irrigated land from Itunundu and Mboliboli villages. However, the villages had a serious conflict about the scheme and land ownership with the prison. The prison had secretly registered the scheme under its name. When the villagers found out in 2001, they had to fight until March 2013 to have the scheme officially returned and registered as IO Mkombozi-TS at the Ministry of Home Affairs. Yet, although the number of prisoners is decreasing, the farmers still complain that the prison expands its land. Thus, although the land ownership is officially established, farmers still question its boundaries. Still, 97 percent of the interviewed farmers (52 out of 54) using Mkombozi-TS state that farm boundaries are clear. Farmers mark their farm boundaries with trees, rocks, and sand dams or piles. Yet, 35 percent of farmers (19 out of 54) reported to have had a land conflict within the last five years. However, it is not clear how many conflicts arose due to unclear farm boundaries among farmers, and how many due to unclear boundaries between farmers and the prison.

In contrast, water access rules are clear and known by the farmers. The IO Mkombozi-TS officially holds the water use permit from the RBWO. This allows farmers to extract 207.360,00 m³ of water per day from December to July to irrigate their fields (RBWO staff, 11/18/2013). However, farmers have to rebuild parts of the intake every year to block the river and lead the water into the irrigation canals. Then, with increasing rains, the water level of the river increases and water flows into the canals. With decreasing rains in June and July, the water level in the canals decreases naturally and ends the irrigation season. Thus, the RBWO cannot exactly measure the actual amount of water extracted and hence, the permit is conditional until the intake is properly constructed. Thus, the allocated water amount will be revised once the intake is properly constructed. However, as in Mlengi-IS, the RBWO still checks the closing of the intake.

The use-rules for Mkombozi-TS are informal and differ, depending on the IC managing the canal. Mkombozi-TS has two main canals. One canal goes through Itunundu and the prison area first, whereas the other one goes directly to Mboliboli area. IC Itunundu manages the former, whereas IC Mboliboli manages the latter, with different use-rules co-existing without creating constant conflicts. However, the IO Mkombozi-TS has existed only since March 2013 and the first attempt to implement its formal constitution failed. Thus, besides the

RBWO, the village ICs are still the main political actors defining the irrigation regime, based on informal rules, norms and conventions. According to the IC Itunundu, Mkombozi-TS and Mlenge-IS have the same use-rules: inspect the canal before irrigating, take as much water as the farm needs, and close the canal when the farm has enough water.

However, besides the use rules, the IC Mboliboli stated that they have rules for when to extract water within the scheme, and on how to use water in times of scarcity. Farmers are only allowed to take as much water as they need when a lot of water is available. When water is scarce, the IC Mboliboli advises farmers on how to use the water to ensure a fair water distribution. This is governed by entirely informal institutions; however, more detailed information was not available, while farmers interviewed did not mention getting advice from the IC in times of water scarcity. Further, farmers whose farms are closer to the intake are also supposed to let water go to the tail end first before starting to irrigate (personal interview with IC Mboliboli, 11/1172013). This indicates that there has been a problem that farmers at the tail end were lacking water and that now rules exist to make water distribution more equal. However, whether the IC Mboliboli enforces these rules is questionable, since 82 percent of farmers (44 out of 54) state that the farmers closer to the intake get more water than the ones at the tail end. Thus, the IC Mboliboli does not actively guide water distribution; rather it is, as in Mlenge-IS, the power relations between farmers closer to the intake and the ones at the tail end.

However, with a lack of official rules, the arrangements among neighbouring farmers become equally important. Even more farmers than in Mlenge-IS (87% or 46 out of 53) stated they had informal rules for water distribution with their neighbouring farmers. Farmers agree among each other to block canals in order for every farmer to get water. Likewise, 65 percent of farmers (35 out of 54) stated that the water use-rules are clear. However, it is unclear whether farmers refer to the rules among each other or to the ones made by the IC. Concerning the informal rules among farmers, only seven farmers (13%) reported that these led to conflicts over water use. Thus, as discussed for Mlenge-IS, farmers follow egoistic as well as social rationalities and are hence more or less willing and able to cooperate with their neighbours. Nonetheless, results suggest that farmers in Mkombozi-TS are more willing to cooperate than in Mlenge-IS, since there are fewer conflicts among them. This indicates that a smaller irrigators-community, such as the one of Mkombozi-TS, has a greater feeling of trust

and reciprocity among them than farmers of a bigger community, sharing a scheme with six other villages.

Yet, besides the farmers who have their own informal rules, there are also farmers in Mkombozi-TS who do not know about any rules. 26 percent of farmers (14 out of 54) stated that they neither knew about the access-rules nor the use-rules. This suggests on the one hand, that farmers who live in Mboliboli are less aware of the rules for Mkombozi-TS, than in Itunundu, where farmers also use Mlengi-IS. Thus, although not necessarily clear, the fact that Mlengi-IS and its rules are also used and influenced by six other villages, may lead to generally more awareness about the rules. On the other hand, this suggests that the IC Mboliboli does not function as a guiding actor in daily irrigation management. Likewise, daily irrigation management is merely based on informal and socially embedded institutions. Thus, as Cleaver (2007) argues, farmers are neither always conscious about the rules nor are they consciously 'crafted'.

Summing up, in both schemes, community boundaries are clear and known, but questioned in practice. The issue of seasonality of the resource boundary, as mentioned by Cleaver and Franks (2005), is partly avoided by the ban on irrigation during the dry season. Yet, due to the traditional intake in Mkombozi-TS the water flow into the scheme is difficult to regulate and the resource boundary thus a bit fuzzy. Further, in both schemes, farmers illegally cultivate on the river banks, suggesting that farmers do not always follow the official rules, although they are clear. Likewise, farm boundaries are not always clear in practice, which, for a few farmers, leads to conflicts. Especially in Mkombozi-TS, where a land ownership conflict with the prison made farmers question the official establishment of the boundaries.

Water access-rules are clear and known, but not necessarily followed. The IOs of both schemes hold a formal water permit with access-rules, made and enforced by the RBWO. IO Mkombozi-TS holds only a conditional water permit until the intake is constructed. However, although a constitution with clear and official water access-rules exists, the RBWO does not have the capacity to regularly monitor compliance and farmers do not always follow them. Thus, in Mkombozi-TS, farmers illegally irrigate on a smaller scale during the dry season because the intake cannot be closed.

Moreover, in both schemes, water-use rules are not clear and merely informal. In Mlengi-IS, there are no rules about the time and the amount of water each farmer is allowed to extract; in

Mkombozi-TS, they existed but were not enforced. Instead, water use-rules were still mainly informal norms and conventions: both, unconscious every day actions, and consciously defined rules by the ICs and the farmers. Concluding, up to now, daily irrigation management in both schemes is primarily informal. This, on the one hand, increases trust and reciprocity among the cooperating farmers. On the other hand, this led to some conflicts over water use; reflecting internal power relations while reinforcing existing inequalities due to gender and economic status.

5.2.2 Balancing costs and benefits of a formalized irrigation regime

Water access and use-rules define farmers' costs and benefits of irrigation. Following mainstream institutionalists, farmers perceive rules as fair and thus, comply with them when they ensure that costs and benefits of a formalized irrigation regime are balanced. In the study's case, costs of a formalized regime are: paying a water use fee per acre, and participating in cleaning the canals. These costs shall be balanced by the following benefits: more efficient water use, more equal water distribution through improved scheme management and infrastructure, thus, increased rice yields and income. Yet, critical institutionalists argue that costs and benefits are rarely balanced, because rules tend to benefit more the ones who make them; fairness rather depends on the willingness of the rule-makers and external guidelines to also include the poorest. Indeed, this study suggests that benefits are few while costs tend to increase with formalization, especially for the poor. Yet, the results also show a contradiction to this imbalance: the majority of farmers perceive rules as fair.

Mlenge semi-improved scheme

From a farmer's perspective, benefits, such as more and more equal water distribution through improved scheme management and infrastructure, are not clear. Only 62 percent of the farmers (13 out of 21) get enough water to irrigate their fields. Following the mainstream institutionalist view, farmers thus, perceive rules as unreasonable (Ostrom 1990). Indeed, half of the farmers who did not get enough water also stated that water access and distribution is not fair and costs are higher than the benefits. Yet, as suggested by critical institutionalists such as Cleaver et al. (2005), also external restrictions negatively affect the balance of costs and benefits: last season's (2012/2013) low rice prices, and the ban on irrigation during the dry season.

In contrast to the benefits, the costs are obvious from a farmer's perspective. Farmers pay a yearly water use fee of 10,000TSh (5€) per acre rented or owned land. Moreover, they have to participate in cleaning secondary and smaller canals; an excavator is hired to clean the main canal. As recently mentioned, the RBWO's restrictions of irrigation to the rainy season are costs as well. Farmers are very aware of this cost, also because it turns into a benefit for their strongest competitor, the hydropower company. They use the river to produce electricity; however, not for the affected farmers. Thus, farmers' rationality is focussed on maximising their own profit from irrigation, yet, rather social, because the share of the water-use fee is relatively small compared to other costs; thus, it would not justify complaints from an economic calculative point of view. Indeed, half of the farmers (11 out of 21) state that the costs are not balanced with the benefits they get and that the water-use fee they pay is too high in relation to the amount of water they get.

Nonetheless, the majority of farmers perceive the access and use-rules as fair. Only, 10 percent perceive them as unfair. This suggests, on the one hand, that 'fairness of access and use-rules' was formulated too fuzzy and farmers did not refer to the rules defining costs and benefits, such as the water-use fee. On the other hand, this also suggests, as stated for example by Cleaver (2012), that one farmer may follow different rationalities. Thus, depending on the context, she or he perceives rules of irrigation management as fair while perceiving costs and benefits as rather imbalanced. However, 28 percent (6 out of 21) of the farmers did not know if the rules were fair, indicating that rules were rather habits of everyday irrigation practice, as suggested in section 5.2.1. Thus, farmers are rather unconscious about their habits and are hence not able to judge their fairness (Cleaver 2007).

However, they are conscious about rules, when they are directly affected. Thus, when it comes to distribution of water along the canal, 90 percent of the farmers (19 out of 21) agree that water is fairly distributed. During water scarcity, these perceptions reverse: only 38 percent of farmers (8 out of 21) agree, 43 percent (9 out of 21) disagree that water is distributed fairly. Yet, in times of water scarcity, four farmers (19%) argued either that there is no irrigation taking place, or that distribution is not a matter of fairness; it rather depends on the location of the farm. Thus, perception of fairness is rather ambiguous and farmers' statements are not consistent. Half of the farmers state that costs and benefits are *not* balanced, but rules *are* fair. In times of water scarcity, more farmers seem to experience water shortages; a clear majority perceives of water distribution as unfair.

Mkombozi traditional scheme

Also in Mkombozi-TS, farmers do not see any improved scheme management and, consequentially, no benefits. A majority of 59 percent of the farmers (32 out of 54) reported to get enough water to irrigate their fields. Thus, following the mainstream institutionalist view, 44 percent of farmers (22 out of 50) state that the costs not balanced with the benefits they get, and half of the farmers stated that the water use fee they pay is too high in relation to the amount of water they get. As in Mlenge-IS, external restrictions negatively affect the balance of costs and benefits, as stated by Cleaver et al. (2005). Indeed, income from rice was low due to low rice prices in the last season (2012/2013), as well as the ban on irrigation during the dry season.

In contrast to the benefits, the costs in Mkombozi-TS are obvious for all farmers; however, some farmers seem to have higher costs than others. As in Mlenge-IS, farmers participate in cleaning the canals; only the main canal is cleaned with an excavator. In contrast to Mlenge-IS, farmers pay an official water use fee of 10,000TSh per year and acre of land they cultivate, rather than per acre owned or rented. Nonetheless, some farmers stated that the payment of the official water use fees is unfair and lacks transparency because the number of cultivated acres per farmer is not properly assessed. One woman who cultivates two acres stated: “you pay almost the same as your neighbour who has 10 acres” (respondent no 27, Itunundu village, 10/26/2013). Indeed, the IC Mboliboli only estimates the number of acres by asking farmers and by a sense of proportion. Since a large area is more difficult to estimate, it is easy to omit a few acres; thus, farmers cultivating many acres often pay less, although they are the already wealthier ones (total household income increases with number of acres owned).

Thus, power relations between farmers and the IC, and informal rules influence the costs of irrigation: costs of irrigation for poorer farmers increased while the already wealthier farmers benefited by paying less. Besides the fees, farmers also perceive the RBWO’s restriction of irrigation as a cost for the same reason than farmers in Mlenge-IS: the hydropower company downstream uses the river to produce electricity, but not for the affected farmers. Thus, benefits are few, while costs increased with the formalization of the scheme.

Nonetheless, farmers perceive water distribution as fair. As in Mlenge-IS, 61 percent of farmers (33 out of 54) stated that access and use-rules are fair, whereas only 10 percent disagree. However, there are also farmers (29% or 16 out of 54) who did not know if the rules

are fair, indicating that rules were rather habits of everyday irrigation practice, as also suggested in section 5.2.1. Thus, farmers are rather unconscious about their habits and hence, are not able to judge their fairness (Cleaver 2007). When it comes to the fair distribution of water along the canal, farmers in Mkombozi-TS perceive the distribution less fair than farmers in Mlengi-IS. Only 72 percent of the farmers (39 out of 54), as opposed to 90 percent in Mlengi-IS, agree that the distribution along the canal is fair, whereas 28 percent disagree. Yet, during scarcity, perceptions reverse: only 27 percent of farmers (14 out of 54) agreed that water distribution is fair; the majority disagreed (73% or 38 out of 54). Thus, as discussed above, farmers are aware of rules and their fairness once they become visible; in this case through water shortage. However, farmers' perceptions remain contradicting: 39 percent of farmers (14 out of 36) perceived of access and use-rules as fair while of costs and benefits as unbalanced. This indicates that farmers do not necessarily link access and use-rules to costs and benefits. Likewise, it indicates that farmers associate fairness of rules only with the scheme-level and not with water distribution between the scheme-users and more distant water-users, such as the hydropower company.

Summing up, regardless which scheme was used, farmers' perceptions of well balanced benefits and costs of irrigation did not provide clear and consistent results. At least half of the farmers in both schemes have contradicting perceptions: benefits and costs are perceived unbalanced, whereas access and use-rules are perceived fair. It seemed that only when farmers could directly experience presence or absence of fairness, rules, or external restrictions, farmers made clear statements. For example, about water distribution along the canals: when water was available, a clear majority ($\geq 20\%$) of farmers in both schemes perceived water distribution as fair. When water was scarce, the majority of farmers perceived water distribution as unfair. Indeed, power relations between farmers closer to the intake and at the tail end, and between poorer and richer farmers became visible, an argument also made by critical institutionalists, such as Hall et al. (2014). Concluding, with the formalization of the irrigation regime, the benefits of irrigation decreased while the costs increased.

5.2.3 Rule-making for water access and use

Mainstream institutionalists treat communities as 'socially' homogeneous, assuming that every individual has more or less the same saying in decision-making processes. Thus, if communities make their own access and use rules, these rules automatically balance costs and

benefits, serve all members equally, and also fit the ecological conditions of the river (Ostrom 2008). Critical institutionalists will argue that communities are socially heterogeneous and permeated by power struggles. Further, they argue that communities modify existing rules rather than purposely craft new ones. Hence, rules are usually made by the local elites, reflecting the power relations and enforcing the existing inequalities among farmers (Cleaver 2007). The following results show that rules, as suggested by mainstream institutionalists, are made by community members. However, the communities tend to be heterogeneous, as suggested by critical institutionalists. Thus, rules are rather made by the local elites, often under exclusion of poorer farmers. Another issue in both schemes is a lack of official use-rules.

Mlenge semi-improved scheme

In Mlenge-IS, mainly community external and local elites make the rules on the general village meetings. However, poor and female farmers are often not heard; they are rather excluded from participating in election processes and thus, from influencing irrigation management. Thus, the main rule-makers are the RBWO, the IO Mlenge-IS, the IC of Itunundu and the ICs of the other six villages using the scheme. The IC Itunundu consists of farmers from Itunundu village and thus, rules are made by community members, as suggested by mainstream institutionalists. However, these members often have had an influential position in the village government or a political party before (personal interview with IC Itunundu, 10/30/2013). Hence, they are – in one way or the other – part of the local elites.

Indeed, observations from a general village meeting as well as farmers' perceptions confirm this: local elites make the rules, female farmers are not heard, and poorer farmers rather excluded from the elections. About one percent of the village population (circa 50 out of 5000) attended the village meeting in Itunundu, thereof about five women; about 20 of these were farm *owners* and hence, potential voters and candidates for the IC. Throughout the whole meeting, only five to six men from the audience led the discussion, only one woman raised her voice. The majority of these speakers were farm owners, and one of them was also a former IC member. Thus, the farm owners, representing an elite and a mainly male minority, participated in the election and represented the new IC; farm *renters* were sent away.

Moreover, the majority of interviewed farmers in Mlenge-IS (66% or 14 out of 21) perceived rule-making as the responsibility of village leaders or other authorities, rather than as an

opportunity for own participation. Likewise, their statements reflected the observed gender dynamics: from the interviewed farmers, almost half of the women (8 out of 18) stated to not go to village meetings. The other half stated to go, but only 33 percent of them (6 out of 19) stated to actively participate. Of the interviewed men, 52 percent (11 out of 21) actively participated, whereas 29 percent (6 out of 21) did not go. Taking a closer look at the ones who do not participate, the majority belongs to the 30 percent with the lowest total household income. Thus, supporting Cleaver's (2007) argument, these farmers may lack resources to participate in village meetings due to social responsibilities, such as caring for young children or sick relatives.

Finally, these observations and statements confirm the heterogeneity of communities which lead to unfair rule-making and hence, rules; the inequity of these rules is reinforced by the lack of clear and official use-rules. Supporting the critical institutionalist view, rules are not fair to all farmers but rather benefit the wealthier ones. Further, there are no regulations on when and how much water each farmer can extract once the irrigation season started (personal interview with IC Itunundu, 10/30/2013). Therefore, as mentioned under 5.2.1, farmers have informal agreements among each other. However, these agreements are mostly unfair to the ones with a lower social status. Thus, in addition to unfair rule-making, the partial 'non-existence' of official rule-making also leads to unfair irrigation practices.

Mkombozi traditional scheme

Similar to Mlengi-IS, in Mkombozi-TS external authorities and the local elites make the rules for irrigation. Yet, farmers' perceptions of rule-making vary more than in Mlengi-IS. However, officially, the RBWO as an external actor makes the water access-rules. And, representing the local elite, the IO of Mkombozi-TS, and the ICs of Itunundu and Mboliboli make the formal water use-rules. This is supported by half of the farmers interviewed (26 out of 52); they perceive rule-making as the responsibility of the village leaders or other authorities rather than as an opportunity for own participation. However, about 20 percent of farmers (11 out of 52) claimed that they make the rules themselves, whereas about 30 percent of farmers (15 out of 52) do not know who is making the rules. This suggests that these farmers either perceive of rule-making as agreeing with their neighbours about water distribution, or are not conscious about the rule-making. Thus, half of all farmers interviewed do not associate the village meeting with rule-making and active participation.

Hence, following critical institutionalists, the question becomes if the village meeting is the place where use-rules are actually made. Results suggest that at least for half of the farmers it is merely a symbolic place; actual use-rules are rather made outside these public places, as argued by Cleaver and Franks (2005). Moreover, this indicates that the formal rules are not enforced; neither the IC nor the IO enforces their constitutions. Thus, farmers follow informal use-rules, some consciously and some rather unconsciously. In either case, these use-rules reflect the social power relations among farmers and thus, lead to fair or unfair arrangements.

Concluding, in both schemes, external authorities make the formal *access*-rules, which determine the frame for the formal *use*-rules which are made by the local elites of the communities. Thus, the farmers cannot determine their own rules for accessing the resource and defining the community. Hence, as suggested by mainstream institutionalists, farmers tend to neither have a feeling of ownership and responsibility to protect the river, nor a strong feeling of trust and reciprocity within the scheme community (Ostrom 2008). The latter only applies to smaller communities of neighbouring farmers. Meanwhile, the local elites – IOs, ICs, and farm *owners* – make the formal use-rules, in accordance with the official access-rules of the RBWO. However, they do not enforce their official constitutions to govern daily irrigation activities. Thus, they remain rather ‘empty shells’ and the governing rules are made during daily irrigation rather than in public fora, such as village meetings (Cleaver 1999; Cleaver & Franks 2005).

5.2.4 Monitoring of irrigation schemes

However the rules, they need to be enforced; thus, it is necessary to monitor the irrigation schemes. According to mainstream institutionalists, monitoring – done by community internal monitors – creates a sense of obligation: for the monitors to impose fair sanctions on rule-breakers, and for the farmers to ensure cooperation among irrigators. However, critical institutionalists argue that due to power relations, poorer farmers are often excluded from the election of monitors and thus, also from monitoring activities. Hence, in case of conflict, social inequalities are reinforced which leads to the further exclusion of poorer farmers. The following results support the critical institutionalists view: they display a general lack of monitoring in both schemes, and the monitoring that takes place rather reinforces inequalities.

Mlenge semi-improved scheme

The election of monitors is done by community members, yet, under exclusion of the farm renters and thus, the poorest of the farmers. The monitors for Mlenge-IS are the IC Itunundu, and the monitors from the other villages. The IC is elected on the general village meeting according to the formal IC-constitution. Farm *owners* who live in Itunundu elect and are elected into the IC by secret ballot, regardless which scheme they use; farm *renters* were sent away by the village leader. With that, the IC excludes farmers from participation in the election of monitors and thus, from monitoring itself. Indeed, 41 percent of the interviewed farmers are farm *renters*, the majority of them belonging to the 30 percent with the lowest total household income. Instead, the IC gives some additional influential power to farm owners. Thus, as suggested by mainstream institutionalists, the election of monitors is done by community members. Yet, supporting the critical institutionalist view, by excluding farm renters from the election of the monitors and from monitoring itself, the IC constitution predefines increasing inequalities in daily irrigation management in Mlenge-IS.

Moreover, IC members do not monitor Mlenge-IS regularly, despite official rules. Being farmers themselves, they argue to not have time to monitor because monitoring coincides with times of intensive farming activities. Further, poor irrigation infrastructure and dirt-roads make it difficult to get to the canals during the farming season (personal interview with IC Itunundu, 10/30/2013). Indeed, the IC members are well aware that they break the rules, as are the farmers. However, the IC members do not get any sanctions for breaking the rules and thus, they continue breaking them. This contradicts Ostrom's (2008) argument of monitors feeling a sense of obligation towards their fellow farmers to implement official rules in a fair way. The monitors rather make use of their elite position and override official rules. Thus, these inequalities between monitors and farmers also challenge the 'unitary community myth', while reflecting critical institutionalists arguments of local communities being socially and economically diverse, and being conflicting as well as understanding (Clever 1999).

Mkombozi traditional scheme

Election of monitors and monitoring of Mkombozi-TS is done by community members of the IO of Mkombozi-TS; yet, farmers follow the official constitutions of the respective IC, but not the IO-constitution. Mkombozi-TS has two main canals; one leads directly to the village lands of Itunundu, the other one to the lands of Mboliboli village. In Itunundu, the IC is thus also the responsible monitor for the part of Mkombozi-TS that serves Itunundu lands. Hence,

farm *owners* elected their IC as a monitor for both Mlengi-IS and Mkombozi-TS, according to the same rules and at the same time as described above. Only farm owners can vote, whereas farm renters are excluded from the election of the IC. Yet, this is in contrast to the recently registered constitution of the IO of Mkombozi-TS, which allows farm *owners* and farm *renters* to vote and to be voted. Thus, as for now, the IC Itunundu only follows its own constitution and does not implement the constitution of IO of Mkombozi-TS.

IC Mboliboli represents the monitors for the part of Mkombozi-TS which serves the village lands of Mboliboli. In Mboliboli, farm *owners* elect the monitors according to the IC constitution, because the implementation of the IO-constitution has failed. Farm *owners*, who live in Mboliboli vote and are voted into the IC on the general village meetings; yet, with the new constitution of IO Mkombozi-TS, both farm *owners* and *renters* can vote. Thus, on the general village meeting the village leader suggested, in conjunction with the election of a new IC, to implement the IO-constitution of Mkombozi-TS. Therefore, the village meeting was promoted as being only for members of the IO and thus, for the minority of farmers. Yet, the majority of farmers who attended the meeting were not members and they had not seen the IO-constitution. Thus, they did not want to become members and rather wanted to postpone the implementation to next year. However, the meeting was interrupted due to rain and thus, the implementation of the IO-constitution failed. Rather, what became clear is that rule-making was done by local authorities and without participation of the farmers: farmers' scepticism towards the implementation of the constitution confirms this.

However, in Mboliboli, the IC monitors Mkombozi-TS once a season, after they opened the intake for irrigation, but not more regularly. The IC ensures that every farmer gets water and also determines the size of the farms according to which farmers pay their water-use fee. However, the IC does not monitor throughout the season, despite official rules, because, as in Itunundu, monitoring coincides with intensive farming activities (personal interview with IC Mboliboli, 11/11/2013). Similarly, the IC Mboliboli is aware of breaking the official rules but does not face any consequences either; thus, it continues breaking the rules. As mentioned for the IC Itunundu, this behaviour shows that the IC Mboliboli does not feel a sense of obligation towards the other farmers to fairly implement the rules. This, again, supports critical institutionalist views that communities are heterogeneous and permeated with social and economical inequalities; the latter being dynamic, differing over time and among farmers

(Cleaver 1999). This allows the ICs to make use of their elite position and to ignore their duties without further consequences.

Summing up, ICs' monitoring of the schemes resembles a flying visit rather than proper management of the schemes. Despite the official obligations to regularly monitor, they defy official rules and replace them with their own informal institutions. Thus, power relations govern monitoring activities which rather reinforce social inequalities, as suggested by critical institutionalists. Further, ICs are equally political actors as they are economic actors. Thus, their interest in farming and securing their own livelihoods often outweighs compliance with and implementation of rules, especially when these rules increase costs rather than benefits.

Concluding, rules for monitoring rather resemble Cleaver's (2012) 'institutional bricolage': formal rules which are amended or replaced by informal use-rules. Thus, they are rather dynamic and differ depending on farmers' social statuses and relations among each other.

5.2.5 Conflict solving and imposing sanctions

Monitoring is only effective when monitors identify the offenders, solve conflicts, and impose sanctions if necessary. Thus, monitoring becomes a matter of decision-making depending on farmers' and monitors' rationalities. According to mainstream institutionalists, farmers are rational actors. In case of conflict, they base the sanctions on clear and consistent decisions. Thus, sanctions become consequences of the offense. Yet, according to critical institutionalists, farmers are social actors and impose sanctions rather according to what they perceive as socially appropriate. Thus, sanctions are negotiable and approximate compliance with them is often enough. Results support a critical institutionalist perspective. They display that conflict solving and sanctioning resembles an 'institutional bricolage': a mix of formal and informal, traditional and modern institutions, governed by power relations among farmers and between farmers and monitors.

Mlenge semi-improved scheme

In Mlenge-IS, conflicts are common and solved according to a mix of formal and informal institutions. Indeed, 95 percent of the interviewed farmers using Mlenge-IS (20 out of 21) state that conflicts over water use and distribution are common. Conflicts mostly concern blocking of irrigation canals to steal water – especially during water scarcity – as stated by 81 percent (17 out of 21) of farmers. Moreover, 81 percent of the interviewed farmers state that

the ones who block canals are caught; yet, mostly by their neighbours and not by the monitors, that is the IC Itunundu.

The IC Itunundu is responsible for conflict solving in the parts of Mlengi-IS which serve the village lands of Itunundu. However, farmers and the IC Itunundu tell different stories about the way conflicts are solved. According to the IC, a farmer who has a conflict calls the informal leader of her or his canal. This leader then calls the IC in order for them to come and solve the conflict. The farmer who reports a conflict has to pay 10,000TSh compensation to each member of the IC who comes to solve the conflict; if the reporter is not able to pay immediately, they can pay later. The offender is then supposed to pay the reporter back, once he or she is identified (personal interview with IC Itunundu, 10/30/2013). Thus, conflict solving involves compensation payments for the IC which turn into a fine for the rule-breaker. However, it depends on the reporter's willingness to pay the IC whether conflicts are solved in public and by the IC.

Yet, farmers tell a different story about the way and whether conflicts are solved by the IC. Some farmers stated that it depends on 'whether you pay and how much you pay to the IC' in order for them to come to solve a conflict; one woman reported that the IC did not come because she could not pay them. Indeed, 23 percent of the farmers in Itunundu (8 out of 35) stated that conflicts are not solved in a fair way. Thus, it does not only depend on the willingness of farmers to pay the IC but also on their ability. Further, power relations govern the process of conflict solving, indicating that the IC neither follows formal rules nor supports poorer farmers. Thus, in case of conflict, farmers tend to solve conflicts with the help of the informal canal leaders and according to informal rules. Only if these canal leaders cannot solve a conflict, they call the IC to step in.

As suggested by critical institutionalists, the IC follows a social rationality when imposing graduated sanctions. Thus, graduated sanctions – fines or in-kind payments – are not necessarily the logic consequences of the offense. The IC rather imposes sanctions according to what they perceive as appropriate, depending on the offense and the offender. Hence, the sanctions vary, reflecting the social differences among farmers and between farmers and the IC. Moreover, the IC follows a sanction system that is a mix of formal and informal institutions: formal institutions, such as imposing fixed fees on the reporter to pay for solving a conflict, and informal institutions, such as calculating fines depending on the offender and the offense. Still, the majority of farmers in Mlengi-IS perceive these sanctions as being in

relation to the offense (70% or 12 out of 17), and as fair to all farmers (83% or 14 out of 17). This suggests that the IC, although exploiting some of the poorer farmers, complies with the general norms of what is socially acceptable, so that the majority of farmers perceive the sanctions as fair. Further, this also indicates that, although some sanctions are formal and crafted for a certain purpose, they are not necessarily more enduring. On the contrary, these formal sanctions are often amended or even replaced by already existing informal institutions, as argued by Cleaver (1999).

Mkombozi traditional scheme

In Mkombozi-TS, conflicts are common and solved to merely following informal institutions. Indeed, farmers stated that conflicts are common and mainly relate to blocking canals to steal water (86% or 47 of 54), especially during times of water scarcity. Similar to Mlenge-IS, 92 percent of the farmers (48 out of 52) stated that the offenders are caught, mostly by their neighbours. As mentioned in the last section, Mkombozi-TS has two main canals and thus, also both village ICs are involved in conflict solving and sanctioning. The part of Mkombozi-TS which serves the Itunundu village lands underlies the same rules and procedures of conflict solving than Mlenge-IS; accordingly, the other part underlies the IC Mboliboli.

As in Mlenge-IS, farmers and the IC tell different stories about the ways of conflict solving and sanctioning in Mkombozi-TS. According to the IC, the offender is brought to the village office and the IC chairperson decides whether to impose sanctions. In case sanctions are imposed, the chairperson of the IC estimates the fines, depending on the offense and the number of affected farmers. Further, according to the IC, farmers do not have to pay compensation to the IC for solving the conflict (personal interview with IC Mboliboli, 11/11/2013). However, 28 percent of the farmers (11 of 39) state that the conflicts are not solved in a fair way: some farmers stated that the IC solves conflicts only when it gets paid; another farmer stated that “the IC only comes to get the money but not to solve the conflict” (personal interview with a farmer in Mboliboli, 10/31/2013). Thus, depending on the social relation between the IC and the offender, the IC imposes fees, respectively gets paid for solving a conflict. Thus, the IC acts according to a social rationality with power relations governing the merely informal processes of conflict solving and sanctioning.

In accordance with this, farmers in the part of Mkombozi-TS which underlies IC Mboliboli, perceive the sanction system differently, which reflects the social and economical differences among them. Thus, 66 percent of them (23 out of 35) state that the sanctions are in relation to

the offense, as compared to 70 percent (12 out of 17) in Mlenge-IS. Further, only 55 percent of the farmers (19 out of 35) in Mkombozi-TS agreed that the sanctions are fair to all farmers, whereas 83 percent (14 out of 17) agreed in Mlenge-IS. Thus, farmers in Mkombozi-TS perceive the sanctions as less fair than farmers in Mlenge-IS. Some farmers argued that the fines for blocking a canal go up to 300,000TSh, which they perceive as not acceptable; especially, because due to poor irrigation infrastructure and unlevelled farms, some farmers are forced to block irrigation canals in order to get water.

Summing up, in Mlenge-IS, conflict solving and sanctioning follows a mix of formal and informal rules, whereas in Mkombozi-TS the system is merely informal. In both schemes, power relations permeate the processes of conflict solving and the determination of the sanctions; however, farmers in Mlenge-IS perceive them as fairer than in Mkombozi-TS.

5.2.6 Costs of conflict solving

According to mainstream institutionalists, a communal monitoring system aims to solve conflicts immediately, at the lowest level and the lowest possible costs. In case of the two schemes, these are the village ICs, which are supposed to solve conflicts at lower costs than higher government authorities. However, critical institutionalists argue that conflict solving is always costly because it includes negotiations and is governed by internal power relations. Also, farmers are willing to increase costs of conflict solving in order to achieve a socially preferable solution. This is reflected in both schemes as farmers as well as the ICs negotiate conflict solving rather than merely follow a set of formal rules.

Mlenge semi-improved scheme

In Mlenge-IS, conflict solving is always socially costly, no matter if solved in public by the IC, or among farmers themselves. Indeed, although reported as common, conflicts usually stay on the village level, and only rarely reach the ward level (personal interview with the WAO, 11/12/2013). However, official monitoring is very limited and conflicts solving follows a mix of formal and informal institutions. Indeed, 18 percent of the farmers in Itunundu (6 out of 33) stated that only some of the offenders comply with the sanctions, others do not, and some are forgiven, depending on money and social status. Thus, supporting the critical institutionalists view, monitors do not follow a fixed set of rules to approach and solve the conflict at the lowest cost. They rather increase social costs of organisation to

negotiate sanctions among them and with the offender, varying with each case (Cleaver & Franks 2005). Thus, a few farmers reported that they solve the conflicts among themselves or with help of the informal canal leader, rather than calling the IC. This clearly indicates that farmers tend to avoid public confrontation and do not trust the IC as a helpful actor to solve conflicts. Thus, conflict solving is neither fair to all users nor rapid or low-cost, but socially costly, as stated by Cleaver and Franks (2005).

Mkombozi traditional scheme

In Mkombozi-TS conflict solving is always socially costly, although conflicts are often solved on a low level and among farmers themselves. Indeed, the WAO stated that conflicts usually stay on village level and only rarely reach the ward level (personal interview with the WAO, 11/12/2013). Yet, monitoring is limited and conflict solving merely follows informal institutions which change depending on the offender and the offense. The IC chairperson *estimates* the fines, but does not follow a fixed set of rules. Thus, as stated by critical institutionalists, conflict solving is a socially costly process, because it involves negotiations and differs from case to case. Moreover, 30 percent of the farmers (8 out of 27) stated to solve their conflicts themselves rather than calling the IC for help. This confirms that farmers prefer informal and non-public institutions, and only turn to the IC or higher authorities such as the WAO, if conflicts are severe (Cleaver & Franks 2005).

Moreover, in both schemes, costs of conflict solving increase, because the sanctions are not always effective. Indeed, farmers stated that unlevelled farms and poor irrigation infrastructure force some farmers to block irrigation canals in order to get water and ensure their harvest despite possible sanctions. Thus, about half of the farmers in both schemes (59% or 10 out of 17, respectively 46% or 23 out of 50) stated that the sanctions do not reduce the number of violators. This indicates that sanctions are not always effective: in some cases, farmers rather carry the costs of sanctions in order to ensure their harvest and thus, their livelihood. In other cases, they completely avoid sanctions of the IC by solving the conflicts on a lower level: with help of the informal canal leader, or among themselves.

Concluding, farmers' conflicts over water use and distribution were usually solved on village level through costly negotiations. The poorer farmers tend to avoid the ICs and official institutions and thus, public confrontation. Supporting the critical institutionalist view, farmers did not aim for low cost conflict solutions; they rather increase the social costs to

achieve a socially appropriate solution, governed by power relations and informal institutions (Cleaver & Franks 2005).

5.2.7 Links to other users and higher government levels

According to mainstream institutionalists, the ideal communal irrigation regime recognizes and is recognized by other water users, such as the National Park and the hydropower company. Besides this, it is embedded in larger and higher level government structures, which helps to make communal irrigation management more efficient over time and ensures sustainability. Yet, critical institutionalists argue that there is no ideal local regime which could increase its effectiveness over time; it influences and is constantly influenced by higher level government structures. They rather argue that political actors at higher levels should balance the needs of local water users and address the occurring issues of physical scale, communication, and inclusion of other water users throughout the sub-basin and catchment (Cleaver & Franks 2005). In case of this study, the results support the critical institutionalist view: the irrigation regimes are influenced by higher-level governments and institutions, rather than the other way round. Moreover, staffing and institutional gaps between the basin and the village level hinder to completely embed the local regimes in the higher government structures of the RBWO. Instead, issues of physical scale and thus, of communication with and inclusion of different water users occur within the catchment.

At present, the RBWO is the only link between the farmers and the other water users in the catchment. Yet, it fails to balance the needs of the different water users due to a lack of staff resources, and due to water users with high influential powers. On the basin level, the farmers have no representation and thus, rather little power to protect their interests. Hence, as mentioned in section 5.1.1, the RBWO and its institutions restrict the farmers' irrigation regimes rather than protecting their needs against the demands of the hydropower company downstream; leave alone the joint optimisation of fair allocation and use of water between the two. Besides, these power struggles are reinforced by the physical size of the Little Ruaha catchment and the different uses of the water. Although sharing the same water resource, the farmers and the hydropower company are located in different regions and have thus neither direct contact due to local proximity, nor the same interests or problems which could potentially make them cooperate. Both aspects lead to farmers' perception that the hydropower company downstream is a direct and strong competitor rather than an equal

partner; indeed, the hydropower company has a bad reputation for 33 percent of the interviewed farmers.

Moreover, water scarcity adds further challenges to fair water allocation and the incorporation of different interests and institutions (Cleaver & Franks 2005; p. 15). According to farmers' perceptions, water scarcity is increasing: 70 percent of all farmers (53 out of 75) state that access to irrigation water reduced over the last five years; mainly due to less rain, poor infrastructure of the canals, increasing competition, improper use of water and catchment destruction. With increasing water scarcity, also conflicts are likely to increase. Together with restrictions from the RBWO, this may lead to a rather less effective irrigation regime, less sustainable management and potential over-use of the river. This also supports Cleaver's (1999; p. 604) critique of the myth of the resourceful community. Namely, communities tend to be resourceful and thus, capable to solve all sorts of problems, the only prerequisite being sufficient mobilization of their resources. Yet, as displayed by the results, communities struggle with physical water shortages and a ban on irrigation during the dry season.

Finally, looking at the broader picture of water allocation in the study area, we see that irrigation is banned during the dry season to ensure water for hydropower generation. This implies that the state does not only favour hydropower over irrigation, but also bans the most valuable irrigation season and thus, income source for the farmers. This tendency reveals similarities to the findings from Van Koppen and Tarimo (2014). In the Wami/Ruvu basin in Tanzania, 89 percent of water was allocated to the 30 large-scale users, whereas only 11 percent to the 930 small-scale users. Thus, it is a question if the formalization of irrigation regimes leads to reduced water-access for irrigating farmers and to water re-allocation which favours commercial users.

5.2.8 The differences between the schemes

Having discussed the institutional characteristics of the two irrigation schemes, this section aims to point out the differences between Mlengi-IS and Mkombozi-TS (Table 2). The schemes differ most clearly in their water intakes which further leads to differences in the level of formality of the governing institutions. The semi-improved scheme has a constructed water intake which allows regulating and controlling the amount of water flowing into the

scheme. Thus, resource boundaries are clear and access-rules, that is, the water permit from the RBWO, are formal and implemented.

Table 2: Institutional characteristics of the two irrigation schemes

| Institutional characteristics | Mlengi semi-improved scheme | Mkombozi traditional scheme |
|--|--|--|
| 5.2.1 Farm, resource & community boundaries; access & use rules | <p>Resource & farm boundaries clear; in practice, some farmers question them & use resource illegally.</p> <p>Formal water access-rules in form of water permit, rules <i>clear & known</i> but <i>not</i> made by community.</p> <p>Use-rules <i>unclear</i>; instead, farmers have informal rules, especially in times of scarcity.</p> <p>Use-rules <i>unclear</i>, governed by power relations & influenced by social status, for some farmers rules are <i>contentious</i>.</p> | <p>Resource boundaries <i>unclear</i> due to traditional intake; former conflict over scheme ownership. Thus, farm boundaries & parts of village lands <i>unclear</i>.</p> <p>Formal water access-rules in form of conditional water permit, rules <i>clear & known</i> but not made by community.</p> <p>Use-rules <i>unclear</i>, informal, & differ between the two village ICs.</p> <p>IC Itunundu: see Mlengi-IS.</p> <p>IC Mboliboli: rules exist for when to extract water within the scheme & how much when it is scarce, but rules not always enforced. Thus, informal rules among neighbouring farmers are equally important. These contentious for some farmers.</p> |
| 5.2.2 Balancing costs & benefits | <p>Benefits <i>unclear, few</i>. No improved water distribution.</p> <p>Costs <i>clear</i>. For 50% of farmers the costs <i>not</i> balanced with the benefits they get; water-use fee is too high in relation to the amount of water received.</p> <p>External restrictions <i>negatively</i> affect the <i>balance of costs & benefits</i>: low rice prices, and the ban on irrigation during the dry season.</p> <p>In contrast, access & use-rules are perceived as <i>fair</i>, some do not know if rules are fair.</p> | <p>Benefits <i>unclear, few</i>. No improved scheme infrastructure and management.</p> <p>Costs <i>clear & increase</i> with formalization of scheme for poorer farmers; farmers cultivating many acres often pay less. Transparency issue. For 44% costs not balanced with benefits.</p> <p>External restrictions <i>negatively</i> affect the balance of costs & benefits, as in Mlengi-IS.</p> <p>In contrast, access & use-rules perceived as <i>fair</i>; yet, some do not know if rules are fair. Water distribution along the canal is perceived less fair than in Mlengi-IS.</p> |
| 5.2.3 Rule-making for water | <p>Rule-making by <i>local elites & external authorities</i>, female farmers are not heard, <i>poorer</i> farmers rather <i>excluded</i> from election on general village meetings. Farmers perceived rule-making as <i>responsibility of village leaders</i> or other authorities,</p> | <p>Rule-making by <i>local elites & external authorities</i>. Farmers perceived rule-making as <i>responsibility of village leaders</i> or other authorities, <i>not</i> as an <i>opportunity for own participation</i>.</p> <p>These informal use-rules <i>reflect social power relations</i> among farmers,</p> |

| | | |
|---|--|---|
| access & use | <p><i>not as an opportunity for own participation. Community heterogeneous & governed by power relations. Thus, unfair rule-making & rules; in addition partial 'non-existence' of official rule-making leads to unfair irrigation practice.</i></p> | <p>thus lead to unfair arrangements for the poorer. 50% of farmers <i>make rules themselves</i> or do not know who is making them. <i>Rules rather made outside public places.</i></p> |
| 5.2.4 Monitoring of irrigation schemes | <p>Election of monitors: farm <i>owners</i> elect the IC Itunundu according to the IC constitution, the <i>poorest</i> farmers are excluded. Thus, IC <i>constitution predefines increasing inequalities</i> in daily irrigation. No regular monitoring by IC despite official rules; only once during the whole season. IC has elite position and overrides official rules and replaces them with informal rules without any consequences. Community heterogeneous and <i>power relations govern monitoring activities.</i></p> | <p>Election of monitors in Itunundu: identical to procedures for Mlengi-IS. Election of monitors in Mboliboli: farm <i>owners</i> elect the IC Mboliboli according to the IC constitution. No regular monitoring by IC despite official rules; only once at beginning of the season. IC Mboliboli has elite position and overrides official rules and replaces them with informal rules without any consequences. Community heterogeneous and <i>power relations govern monitoring activities.</i></p> |
| 5.2.5 Conflict solving & sanctioning | <p>Conflicts common (stealing water & blocking canals). Conflict solving according to <i>mix of formal & informal institutions</i>, involves compensation payments for the IC which turn into fine for the rule-breaker. IC follows a <i>social rationality</i>, thus, <i>power relations govern the process</i> of conflict solving and sanctioning (money or in-kind). Informal canal leaders to solve conflicts among farmers. Some farmers prefer informal leaders and avoid IC.</p> | <p>Conflicts common (stealing water & blocking canals). Conflict solving <i>merely informal</i>, IC follows social rationality, power relations govern the process. IC <i>estimates</i> fines (money or in-kind), depending on the offense and the farmer. Officially no compensation payments, but some farmers have to pay for the IC to come and solve the conflict. Farmers perceive the sanctions as less fair than farmers in Mlengi-IS.</p> |
| 5.2.6 Costs of conflict solving | <p>Conflict solving socially costly, neither fair to all users nor rapid; negotiation of sanctions among IC and with the offender, varying with each case. Usually conflicts stay on the village level, only rarely reach the ward level. Farmers tend to avoid public confrontation prefer solving conflicts without the IC.</p> | <p>Conflict solving is a socially costly process, because it involves negotiations. Conflicts usually stay on village level and only rarely reach the ward level. Farmers tend to avoid public confrontation, prefer solving conflicts without the IC; farmers only turn to the IC or higher authorities such as the WAO, if conflicts are severe.</p> |

Yet, Mkombozi traditional scheme has only a traditional intake and thus, may get more or less water than allocated. The water permit is therefore conditional and will be revised once the intake is constructed. Hence, resource boundaries are unclear and access-rules informal, because the formal access-rules cannot be implemented. Further, a former conflict between the villages and the prison about land and ownership of the traditional scheme makes farmers still question boundaries of farms and village lands. Thus, farm and village-land boundaries are unclear; yet, in the semi-improved scheme, these boundaries are mostly clear (section 5.2.1, Table 2).

Water use-rules became informal in both types of schemes, because the ICs and IOs failed to implement their constitutions. Thus, use-rules differ not only between the schemes, but also within the schemes, depending on the user-community. In the semi-improved scheme which has formally defined boundaries and is used by a big community of seven villages, there are no official or formal use-rules which regulate the water extraction within the scheme; neighbouring farmers rather have informal arrangements among themselves. In contrast, the part of the traditional scheme which is only used by a rather small community of one village has official, yet informal use-rules to ensure equal water extraction (section 5.2.1, Table 2). This suggests that bigger communities and beginning formalization of the irrigation regime leads to less communal spirit and feeling of reciprocity among its users. However, in the traditional scheme, the official rules for equal water distribution are not always implemented; thus, informal rules, permeated with power relations, govern water use.

Moreover, with the formalization of the scheme, the RBWO increased the price of irrigation for farmers in both types of schemes (section 5.2.2, Table 2). Thus, farmers do not perceive costs as balanced with the benefits they get. Yet, findings from the quantitative analysis display that the cost share from the water-use fee accounts on average for only 10 percent of the gross costs. However, at least half of the farmers who stated that costs and benefits are imbalanced still perceived water access and use-rules as fair. Farmers in traditional scheme however, perceived water distribution less fair than farmers in the semi-improved scheme. Indeed, in the traditional scheme, the assessment of the size of the farms, according to which farmers have to pay the water use-fee, lacks transparency. Especially the ones with many acres often get away with paying less water use-fees. In the semi-improved scheme, only a few farmers reported about corruption related to water use fees. However, one has to keep in mind that the sample size of the farmers using the semi-improved scheme is much smaller and

thus, may be less representative than the sample of the farmers using the traditional scheme. Yet, assessing fairness of community-made and informal use-rules was difficult in both types of schemes. The use-rules are often part of everyday habits and interactions and thus some farmers were not conscious about them and hence, did not know whether these rules were fair. Moreover, some farmers seem to not associate access and use-rules with general costs and benefits of irrigation. Thus, they perceived rules within the scheme as fair while costs and benefits as clearly imbalanced although numbers suggest that they are balanced.

Formal rules are generally made by and divided upon external authorities and local elites; these rules contradict each other and exclude the poorest farmers from rule-making (section 5.2.3, Table 2). Thus, farmers are neither always conscious about these rules nor always follow them. Indeed, in the semi-improved scheme, farmers illegally cultivate on the river banks, whereas in the traditional scheme, farmers illegally irrigate on a smaller scale during the dry season. Hence, governing rules are both formal and informal; informal rules are often made by farmers during daily irrigation, rather than in public at the village meetings. Thus, in both schemes, power relations permeate daily irrigation practice and often lead to unfair outcomes, especially when water gets scarce.

Likewise, election of monitors and monitoring is unfair and influenced by power relations in; conflict solving and sanctioning reflect the community-internal social differences. In both schemes there is no regular monitoring by the ICs; still, offenders are caught and conflicts solved (see section 5.2.4, 5.2.5, Table 2). In the semi-improved scheme, informal canal leaders solve the conflicts; the IC only steps in if conflicts cannot be solved by the informal leaders, following a mix of formal and informal rules. In contrast, in the traditional scheme, conflict solving follows merely informal rules. Farmers either solve conflicts among themselves or with help of the IC; there is no 'intermediary level' for conflict solving, such as the informal canal leaders in the semi-improved scheme. Accordingly, farmers in the traditional scheme perceive the sanctions as less fair than farmers in the improved scheme.

In both schemes, conflicts are common; yet, conflict solving is socially and for some farmers also financially costly and not necessarily fair. Conflicts are usually solved on the village level. Local authorities, such as the ICs, as well as farmers follow a social rationality and always negotiate resolutions and sanctions, rather than following a clear set of rules. Hence, some farmers associate formal institutions with being fairer than informal institutions, although in practice this often proves to be false. For example, some farmers in the traditional

scheme stated that the fairness of conflict solving could increase with the implementation of the new IO-constitution. However, results from the semi-improved scheme suggest that the process of conflict solving still remains mainly informal and unfair, as it favours the rather wealthier farmers and often excludes the poorer ones. Thus, formal institutions are not necessarily fairer than informal institutions; it rather depends on the willingness and social capacity of the interacting people.

Concluding, throughout the analysis, both mainstream and critical institutionalist views provided valuable explanations of the institutional characteristics. Yet, the irrigation regimes in both schemes emerge as a landscape of institutional bricolage, rather than as a clear set of consequential and mutually dependent rules. Rules reflect the power struggles and inequalities of social agency and thus, the beginning formalization of the irrigation regime. In Mlenge-IS, the mix of formal and informal institutions clearly reflects the influence of the RBWO and the NAWAPO and thus, the transition from an informal to a formal regime. In case of Mkombozi-TS, the governing institutions are merely informal, except the water permit from the RBWO. Yet, the traditional intake does not allow implementing this new and formal institution. Interestingly, the political actors who officially manage the schemes in the two villages have still the same organisational structure as before the beginning of the regime formalization. Thus, local political actors (ICs) still manage the semi-improved scheme according to their community-boundaries and institutions, although the state introduced new actors (IOs) to manage irrigation according to scheme-boundaries and formal institutions. Thus, community-institutions and scheme-institutions overlap and partly contradict each other, as also stated by Van Koppen and Tarimo (2014). This suggests that the existing institutions prove to be relatively robust and once again supports critical institutionalists' views that farmers draw on and change existing institutions rather than adopting new ones (Clever 2012).

5.3 Irrigation and Livelihoods

The third focus of this study lies on irrigation and livelihoods of peasant farm households. The reformation of the water sector and increased competition over water leaves farmers in the semi-arid area of Iringa Rural District with restricted water use for irrigation. However, as critical institutionalism suggests, communities are heterogenic and thus, restrictions on water use affect households differently (Clever 2007). Thus, following the sustainable livelihoods

approach (SLA) as discussed in section 3.3, this section first investigates the characteristics of the HHs; more precisely, the different assets a HH can access in order to generate income (Ellis 2000a). The next section then investigates how the HHs are actually generating income and which income shares are the most important. The section ends with investigating how HHs livelihood strategies and dependency on irrigation help or hinder the improvement of environmental sustainability and livelihood security.

5.3.1 Households' Characteristics

When looking at the assets of a HH, we follow Ellis' (2000a) and look at the five different asset categories, as discussed in section 3.3. In order to get a holistic overview about HHs characteristics, we look at the assets in relation to different variables: wealth groups, villages, and irrigation schemes.

RQ5: What are the households' main assets to ensure their livelihoods?

Before looking at the HHs' characteristics by wealth groups, villages, and irrigation schemes, we shall briefly present the average HH in the study area. The average HH-size is 4.7 and most HH have male HH-heads and are married (about 85%). Further, most HH-heads are on average 42 years old and have primary education (86%); their main occupation is farming (98%). Looking at the construction of farmers' houses, 66 percent have roofs made of iron sheet, 34 percent use thatch from paddy. & 1 percent of HHs make their walls out of nurned bricks, 33 percent use sticks with mud plastering. The majority of HHs (70%) get their drinking water from public tabs. The villages do not have proper electricity supply. Thus, energy source for cooking is mainly firewood (about 80%), while energy sources for light are mainly kerosene, battery, or solar (42%, 33%, and 24% respectively). HHs own 4.3 acres of land and rent about 0.75 acres of land on average. Potential farm-income sources are paddy and livestock; yet, only 39 percent of HHs own livestock. Generally, HHs are poor: they have an average net-income of 783€ per year which is around two Euros or US Dollars per day and thus, close to the international poverty line of two US Dollars per day; further, they face food shortages in 2.4 months per year.

5.3.1.1 Assets by wealth groups

The wealth groups are generated according to net HH income, 33 percent (27 out of 80 farmers) of the farmers' population in each group.

Looking at the distribution of human capital among the three wealth groups (Table 3), poorer HHs tend to have generally less human capital than HH of the middle and high-income groups. Indeed, we can see that the HH-size of the low-income group is smaller than the HH-size in the other income groups. Moreover, the share of farmers with no formal education (17%) is about twice as high as compared to the middle-income group (7%). Still, 72 percent of farmers in the low-income group stated to have primary education. However, a smaller HH-size and a lower level of education suggest that the poor HHs in general have fewer and less skilled workers to generate income from farming, and from non-farm sources, such as carpentry, in particular. This may again lead to future marginalisation of the already poor farmers.

Looking at the distribution of physical capital of HHs, it is mainly the farmers in the high-income group that own a power tiller, while only one farmer in the middle-income group (Table 3). Power tillers are not only used for land preparation but also for other purposes which may generate income, such as transporting collected fire-wood from the forest, carrying bricks or paddy bags to the villages. Thus, owning a power tiller not just facilitates and improves land preparation during the farming season and hence, may contribute to a better harvest, but it is also a valuable means of income throughout the whole year. Being rather expensive and difficult to afford, power tillers were first subsidized and distributed through development aid programmes. However, a woman belonging to the middle-income group stated: “the distribution of the power tillers was not fair, only farmers who have ‘names’ got a power tiller. [...] the ones owning a power tiller are on another level, because they get money for everything!” (Respondent no 20, Itunundu, 10/24/2013). Thus, both data and farmers’ perceptions show the high value of a power tiller and further support the critical institutionalist view that communities are socially and economically heterogeneous institutions. Thus, external influences through formalizing institutions and development programmes easily reinforce existing inequalities rather than reduce them (Cleaver 2007).

Moving on to the distribution of natural capital, we look at agricultural land which is owned and rented by farmers and at the livestock they own. Farmers in the high-income group also own the most agricultural land and the highest share of livestock (Table 3). For the agricultural land owned, the Tukey-Kramer HSD test displays significant differences ($P < 0.0001$) between the means of the high and the low-income group and the means between the high and the middle-income group. This indicates that the ones who own more land also

generate more income. These farmers cannot just cultivate a higher number of acres, but also rent their land to other farmers; this is especially profitable because land is getting scarce and thus, more valuable. However, some farmers also give shares of their land to relatives without charging any rent.

Table 3: Average measures of socio-economic factors by wealth groups, Iringa Rural district, Tanzania, 2013.

| Mean | Low income (N=27) | Middle income (N=27) | High income (N=26) | Weighted sample mean (N=80) |
|--|----------------------|-------------------------|-----------------------|-----------------------------------|
| HH head male (%) | 81 | 85 | 85 | 84 |
| Age HH head | 40 | 43 | 45 | 43 |
| Married (%) | 81 | 85 | 88 | 85 |
| Primary education head HH (%) | 72 | 93 | 92 | 86 |
| No formal education (%) | 16 | 7 | 4 | 9 |
| HH size *** | 3.9 ^b | 5.1 ^a | 5.1 ^a | 4.7 |
| Own power tiller (%) *** | 0 ^b | 4 ^b | 39 ^a | 14 |
| Loan yes (%) * | 33 ^a | 63 ^b | 54 ^b | 50 |
| Income was sufficient (%) | 22 | 30 | 54 | 35 |
| HH situation <i>worse</i> compared to 5 yrs ago (%) | 70 | 48 | 42 | 54 |
| Land owned (acre) *** | 1.5 ^b | 1.7 ^b | 9.6 ^a | 4.3 |
| Land rented (acre) | 0.7 | 1.0 | 0.6 | 0.75 |
| Livestock owned (%) ** | 15 | 44 | 58 | 39 |
| Labour received *** | 0 ^b | 2 ^{a,b} | 12 ^a | 4.8 |
| Mean Net HH income/yr | 199€ | 488€ | 1803€ | 818€ |

* significant difference between all wealth groups using *Pearson's Chi-Square* $X^2 = 4.969$, $DF = 2$, $P < 0.08$.

**significant difference between all wealth groups using *Pearson's Chi-Square* $X^2 = 10.817$, $DF = 2$, $P < 0.004$.

*** a, b: different letters between the respective wealth group indicate significant differences; for nominal variables using *Pearson's Chi-Square* $X^2 = 19.90$, $DF = 2$, $P < 0.0001$; for continuous variables using *Tukey-Kramer HSD* test, confidence quantile: $q^* = 2.39$, $\text{Alpha } 0.05$, $P < 0.03$. 1€ = 2140 TSh. 1 acre = 0.4 hectare

The number of rented acres of land is generally very low and not significantly different among the wealth groups. Similarly, farmers in the study area own very little livestock; mainly chicken of which many died due to a disease which has been spreading in both villages. Yet, *Pearson's Chi-Square* test displays significant differences of the share of livestock owned between all wealth groups; the high-income group owned the highest share of livestock ($P < 0.004$). Yet, the weighted sample mean of 39 percent (Table 3) lies between

the low and middle income group, suggesting that generally livestock is not such an important asset and mainly one of the richer farmers.

Looking at the financial capital, one usually investigates cash savings and access to credit. However, in the study area, interviewed farmers did not have cash savings, but half of the farmers took loans from neighbours or savings groups. Pearson's Chi-Square test displays significant differences between the wealth groups at a significance level of 10 percent: 63 percent of farmers in the middle-income group stated to take on loans, 54 percent of the high-income group, and 33 percent of the low-income group (Table 3). One reason to take on a loan was precaution against hunger, especially for wealthier HHs: 27 percent of farmers in the high-income group took on a loan compared to 16 percent of farmers in the low-income group. Poorer farmers rather tend to generate income from wage farm-labour as a precaution measure. Moreover, farmers used loans to invest in petty business, paddy production, or in transport of paddy to the town centre. This indicates that rather exogenous economic factors, such as nationally decreasing paddy prices, locally difficult market access and hence, exploitation by middle men, reduced the access to financial capital in form of cash income (FEWS Net 2014). Thus, exogenous factors may increase borrowing and with that HHs' vulnerability in the long-term, as also stated by Ellis (2000a).

Moreover, these findings support critical institutionalists' views, such as from Cleaver et al. (2005): external economic actors and institutions on higher levels often restrict economic actors and their institutions on village level, especially the already poorer actors. Indeed, 70 percent of farmers in the low-income group stated that their HH is less well-off compared to five years ago, while in the high-income group only 42 percent of the farmers stated the same (Table 3). Moreover, only 22 percent of the poorest farmers stated to have sufficient income for their HHs in the last year (2012) compared to 54 percent in the high-income group. Yet, even among the richest farmers, 43 percent stated to lack sufficient income; only three percent stated that it was reasonable. Looking at the net HH income in absolute numbers, the low and middle-income groups live on 0.54€ and 1.33€ a day. Thus, they live under, respectively close to the international poverty line and are relatively vulnerable compared to people who do not (CPR 2009).

Finally, HH also have social capital in form of social networks among relatives, friends, neighbours, and other irrigators. However, as mentioned in section 3.3, social capital is often difficult to measure and is highly influenced by power relations among farmers. Indeed, the

study's case is no exception: 80 percent of the farmers of each wealth group stated to have a good relationship with their neighbours as well as with other irrigators. Yet, it is unclear, whether these relationships reach as far as helping each other with cash or in-kind payments in difficult economic times, or if they refer to and are limited to rather superficial and daily routines. This holds for both; for farmers within wealth groups and for farmers between different wealth groups. Nonetheless, findings from section 5.2.1 suggest that social capital differs between farmers of different wealth groups. Poorer farmers are often the losers when it comes to conflicts over asset access, because they have less social power than the richer farmers who tend to be the decision-makers when solving conflicts. Thus, losing conflicts over asset access also means to have less income sources from this asset and hence, increases farmers' vulnerability. Moreover, farmers lend each other unpaid labour force. Here, the Tukey-Kramer HSD test displays significant differences, when $p < 0.01$, between farmers of the high and the low-income group in the average number of labour received. Similarly, the majority of farmers who receive labour also give labour. This suggests that farmers mutually support each other if they have the resources. Thus, this seems more common among richer farmers; they own and cultivate many acres, have bigger HHs, and potentially more labour force (HH-size 5.1), than poorer farmers who own only a few acres and have smaller HHs (HH-size 3.9).

Concluding, farmers in the low-income group have generally less capital or assets than the middle and the high-income group. Significant differences between the wealth groups are found within human, natural, physical, and financial capital, while social capital was too difficult to measure. Thus, richer farmers have more human capital to generate income than poorer HHs. This is further complemented by more physical capital, such as a power tiller, which allows richer HHs to improve their natural capital as well as financial capital. In contrast, poorer HHs have less human, physical, and social capital. Thus, poorer farmers also have difficulties to improve their already low natural capital and to generate financial capital. However, before looking at which capital is most important for income generation for each group, we shall look at the HHs' differences by villages and by irrigation schemes.

5.3.1.2 Assets by villages

The two studied villages lie in the same ward, about 70km from Iringa Town; the distance between the villages is about 10km. Farmers in both villages stated that rainfall is decreasing in the area while the number of irrigators is increasing. Thus, water tends to get scarcer over

time and competition over water and land resources tends to increase, especially, because the villages are located in a semi-arid area. Yet, one has to be aware that farmers used the same water source but not the same irrigation schemes: in Itunundu farmers used *either* Mlinge-IS *or* Mkombozi-TS, whereas farmers in Mboliboli used *only* Mkombozi-TS.

When looking at human capital, we can see that there are no significant differences between the two villages (Table 4). Over 80 percent of the HH heads in both villages are married, the remaining share of farmers lives either separated or widowed. The mean HH-size in both villages is with 4.4 and 5.1 slightly higher than the mean size of 4.2 of HHs in Iringa Rural district.

Moreover, the majority of HH-heads (80%) have primary education; of the remaining farmers, the majority has no formal education. Thus, the overall education level of HH-heads is rather low and indicates that only few HHs have skilled workers to generate income from non-farm activities. Two main factors may explain the low education level: the remote location of the two villages and thus, difficult access to secondary education, and the high level of poverty with an approximate net income around 2€ per day and thus, the inability to pay for higher education.

Looking at physical capital, we can see that generally very few farmers own a power tiller: 20 percent of farmers in Mboliboli and eight percent of farmers in Itunundu (Table 4). As discussed in section 5.3.1.1, owning a power tiller not only improves land preparation during the farming season, but also provides an income source throughout the year. The higher mean net income of farmers in Mboliboli supports this observation (Table 4).

Moving on, we look at the natural capital and see that farmers in Mboliboli also own significantly more acres than farmers in Itunundu (Table 4). Thus, the potential income from farming activities is generally much higher than in Itunundu. Yet, farmers stated that agricultural inputs, such as fertilizer, pesticides, and hybrid seeds, are expensive and hence, rarely used. A NGO in Itunundu provided trainings on seed and seedling selection to improve paddy yields; however, only one of the interviewed farmers participated. Thus, paddy cultivation is mainly done with a simple hoe and without any additional inputs. With this rather extensive cultivation form, the mere use of a power tiller makes a relatively big difference in the productivity and hence, in the income from farming. Thus, owning both

more land and a power tiller explains the higher net income of farmers in Mboliboli compared to farmers in Itunundu (Table 4).

Table 4: Average measures of socio-economic factors by village, Iringa Rural district, Tanzania, 2013.

| Mean | Itunundu (N=40) | Mboliboli (N=40) | Weighted sample mean (N=80) |
|--|--------------------|---------------------|-----------------------------------|
| HH head male (%) | 80 | 88 | 84 |
| Age HH head | 41 | 45 | 43 |
| Married (%) | 82 | 87 | 85 |
| Primary education head HH (%) | 87 | 84 | 86 |
| No formal education (%) | 8 | 11 | 9 |
| HH size | 4.4 | 5.1 | 4.7 |
| Own power tiller (%) (counts) | 8 (3) | 20 (8) | 14 (6) |
| Loan yes (%) | 60 | 40 | 50 |
| Income was sufficient (%) | 32 | 37 | 35 |
| HH situation <i>worse</i> compared to 5 yrs ago (%) | 50 | 57 | 54 |
| Low-income group (%) | 30 | 37 | 34 |
| Middle-income group (%) | 45 | 22 | 34 |
| High-income group (%) | 25 | 40 | 33 |
| Land owned (acre) * | 1.8 ^b | 6.8 ^a | 4.3 |
| Land rented (acre) | 0,7 | 0,8 | 0.7 |
| Livestock owned (%) | 47 | 30 | 39 |
| Labour received | 3.3 | 6.5 | 4.8 |
| Irrigation scheme used: | | | |
| Mlengi-IS (No) | 21 | 0 | 10 |
| Mkombozi-TS (No) | 14 | 40 | 27 |
| Mean Net HH income/yr | 673€ | 962€ | 818€ |

*a, b: different letters between the villages indicate significant differences ($P = 0.0035$) between the means of acres owned according to *Tukey-Kramer HSD* test, confidence quantile $q^* = 1.99$, Alpha = 0.05. 1€ = 2140 TSh. 1 acre = 0.4 hectare

However, the data did not provide for a proper explanation as to why farmers in Mboliboli owned almost four times more acres than farmers in Itunundu. One reason may be increasing competition over land for farmers in Itunundu, since half of them use Mlengi-IS which is also used by farmers from six other villages.

In contrast to agricultural land, livestock is generally a small income source in both villages. Farmers owned mainly small livestock, such as poultry and ducks; only very few owned pigs and cattle. In Itunundu, more farmers owned livestock than in Mboliboli (Table 4). Yet, these findings may have been biased by a chicken disease which rapidly spread in both villages. Indeed, about 15 percent of farmers lost chicken due to the disease and thus, a valuable source of food. This suggests that for the majority of farmers, agricultural land is the main natural capital, as is the case for the different wealth groups.

Looking at the financial capital, none of the farmers stated to have cash savings, but many had access to a loan. In Itunundu, 60 percent of farmers took on a loan as compared to 40 percent in Mboliboli (Table 4). As discussed in section 5.3.1.2, farmers used loans to invest in petty business, paddy production, and transport of paddy to the town centre. Some farmers also took on a loan as a precaution against hunger and thus, as a coping strategy: 13 percent of farmers in Itunundu and 28 percent in Mboliboli. Besides that, farmers in both villages store and ration rice, exchange rice with maize, because maize is more filling, and work as wage labour for other farmers in order to prepare themselves for or cope with food shortages. However, despite taking on loans, farmers in both villages stated to struggle with food shortages between 2-3 months per year, especially during the farming season from December to May.

Moreover, in both villages, about 50 percent stated that their HH is less well-off as compared to five years ago (50% and 57% respectively); only about 30 percent of farmers stated that their income was sufficient (32% and 37% respectively), although the data indicates that farmers in Mboliboli have a higher mean net income than farmers in Itunundu (Table 4). Thus, we are taking a closer look at the income distribution: in Itunundu, 45 percent belong to the middle-income group and only 25 percent to the high-income group. In Mboliboli it is vice versa: 40 percent belong to the high and only 22 percent to the middle-income group (Table 4). This indicates that, at least when looking at the net income, farmers in Mboliboli are generally better-off than farmers in Itunundu and may therefore take on fewer loans. Yet, one has to bear in mind that the sample size with 40 HHs per village is less than one percent of the total population and that the calculation of the net income is prone to error; for example, the monetary value of fire-wood collected from the forest is only a rough guess. Therefore, general conclusions, especially derived from monetary incomes, should be treated with caution.

Summing up, the majority of farmers in both villages stated to not have sufficient income and half of them also took on a loan. Thus, they are relatively vulnerable and do not have much buffer in form of cash or food stocks to cope with future shocks. Taking on a loan then becomes a risky strategy to secure the HH's livelihood, since HHs may lose their property and lands in case of insolvency. Concluding, as short-term precaution measures, loans reduce HHs' vulnerability at high risk, while as long-term replacement of income generation from natural capital, loans rather increase HHs' vulnerability.

Finally, we look again at social capital and thus, at the relationship of farmers to their friends, neighbours, and other irrigators. Similar to the results derived from wealth groups, about 90 percent of farmers in both villages stated to have a good relationship with their neighbours and other irrigators. However, as when looking at wealth groups, it is not clear how far these relationships reach and to what extent they imply to financially or socially support each other during difficult times. Moreover, farmers' social capital influences the access to loans as well as the interest rate, especially when they are taken informally. Depending on the social capital, power relations between the involved parties may strongly influence the negotiations as well as the interest rate of a loan and thus, may lead to more or less fair deals. When looking at the unpaid labour farmers received, numbers indicate that in Mboliboli it seems more common to lend labour to each other. However, bearing in mind the results from the wealth-group analysis, the farmers of the high-income group with a higher number of acres also tend to help each other more. Indeed, 62 percent of them live in Mboliboli, which may explain the higher number of labour received as compared to Itunundu.

However, social capital not only concerns relations within or among villages, but also between farmers and pastoralists. In both villages, farmers are affected by conflicts over land and water use: while pastoralists struggle to get water access for their cattle, the latter destroy the irrigation canals of the farmers which may be seen as physical capital. Thus, low social capital among farmers and pastoralists may destroy farmers' physical capital and hence, challenge income generation from natural capital, that is, irrigated paddy cultivation.

Summing up, Itunundu village has generally less capital than Mboliboli village. However, differences between the villages are rather small. Only natural capital and mean net income show clear differences. Farmers in Mboliboli own significantly more acres than farmers in Itunundu and also have a higher mean net income (Table 4). Yet, it is unclear why the villages show these significant differences. Typical factors such as rainfall, market access, or major

land or water policies do not differ between the villages. The villages are located in the same climatic and geographical area, only about 10km away from each other, and also have equally bad market access; respectively obtained the same average market price for the paddy they sold. Thus, another explaining factor may be the potentially different land and water allocation practices between the two irrigation schemes as well as competition over land and water in the schemes. However, this is part of the next section.

5.3.1.3 Assets by irrigation schemes

When looking at the socio-economic factors by irrigation schemes, we have to be aware that the sample sizes for each scheme differ: 21 farmers for Mlenge-IS and 54 farmers for Mkombozi-TS (Table 5). This is because the population was sampled according to villages and not according to schemes; in Itunundu village, farmers used either Mlenge-IS or Mkombozi-TS, whereas in Mboliboli village, farmers only used Mkombozi-TS. Thus, Mlenge-IS was only used by a third of the sampled population. Moreover, Mlenge-IS is also used by farmers of six other villages which were not part of this study but who still may have influenced the natural as well as the social capital of HHs. Finally, three farmers were excluded from the calculation, because they were using both schemes and it was not possible to assess if they used one scheme more than the other.

The investigation of human and financial displayed no significant differences between the schemes, while social capital was too difficult to measure. Yet, physical and natural capital displayed significant differences (Table 5). Taking a closer look at the human capital of farmers who used Mlenge-IS, fewer HH-heads are male and married. Thus, remaining HH-heads are female and widowed or separated and hence, with less labour for income generation; this is also indicated by the smaller HH-size (Table 5).

Looking further at financial capital, more farmers using Mlenge-IS take on loans as compared to farmers using Mkombozi-TS. This indicates that farmers using Mlenge-IS also lack more financial capital than farmers using Mkombozi-TS; the absolute net income reflects this. Yet, one should bear the different sample sizes in mind as well as the number of acres farmers own in the respective scheme.

Taking a closer look at the physical and natural capital, farmers using Mkombozi-TS generally have more than farmers using Mlenge-IS (Table 5). Regarding physical capital, we see that only the farmers using Mkombozi-TS own power tillers (Table 5).

Table 5: Average measures of socio-economic factors by irrigation schemes, Iringa Rural district, Tanzania, 2013.

| Mean | Mlenge semi-improved (N=21) | Mkombozi traditional (N=54) | Weighted sample mean (N=75*) |
|--|-----------------------------------|-----------------------------------|------------------------------------|
| HH head male (%) | 71 | 87 | 83 |
| Age HH head | 44 | 42 | 43 |
| Married (%) | 76 | 87 | 84 |
| Primary education head HH (%) | 86 | 85 | 85 |
| No formal education (%) | 5 | 12 | 10 |
| HH size | 4.3 | 4.9 | 4.7 |
| Own power tiller (%)** | 0 | 19* | 13 |
| Loan yes (%) | 61 | 44 | 50 |
| Income was sufficient (%) | 29 | 39 | 36 |
| HH situation <i>worse</i> compared to 5 yrs ago (%) | 57 | 56 | 56 |
| Low-income group (%) | 43 | 31 | 34 |
| Middle-income group (%) | 43 | 31 | 34 |
| high-income group (%) | 14 | 37 | 31 |
| Land owned (acre) ^{a, b} | 1.3 ^b | 5.4 ^a | 4.2 |
| Land rented (acre) | 0.6 | 0.8 | 0.7 |
| Livestock owned (%) | 38 | 35 | 36 |
| Labour received | 3.0 | 5.7 | 4.9 |
| Mean Net HH income/yr | 404€ | 920€ | 776€ |

*3 HHs excluded because they used both schemes, 1 HH landless, 1 HH missing

**significant difference ($P = 0.05$) according to *Fisher's Exact Test 2-Tail*, that number of power tiller is different across schemes.

a, b: different letters between the irrigation schemes indicate significant differences ($P = 0.0445$) between the means of acres owned according to *Tukey-Kramer HSD* test, confidence quantile $q^* = 1.99$, $\text{Alpha} = 0.05$.

1€ = 2140 TSh. 1 acre = 0.4 hectare

As mentioned before, only the rather rich farmers with a lot of natural capital got a power tiller. Indeed, the number of acres farmers own in Mkombozi-TS is about four times higher than in Mlenge-IS. This suggests differences in land allocation between the schemes. However, there was not enough data to provide for a proper explanation. Yet, in general, land is getting more valuable and water scarcer. Indeed, farmers stated that it is almost impossible to buy land these days within the schemes.

Moreover, farmers using Mlengi-IS face higher competition over land since it is used by seven villages, whereas Mkombozi-TS is only used by two villages. However, one would need to look further into land allocation practices in order to provide a thorough explanation. Moving on and looking at livestock, the share of farmers who owned livestock is almost the same in both schemes (Table 5), as also suggested from the analysis of capital by village and wealth groups.

Yet, access to natural capital, as to other forms of capital, depends on farmers' social capital. In order to access and use water for irrigation, farmers mostly depend on their social capital and other farmers' willingness to cooperate, as also discussed in section 5.2. Thus, social capital concerns relationships within the schemes rather than among schemes, and more particular among farmers of different wealth groups.

Summing up, farmers using Mlengi-IS have generally less capital than farmers in Mkombozi-TS. Land is farmers' main natural capital in both schemes. Yet, farmers in Mkombozi-TS have significantly more natural capital and thus, more potential to create income from farming activities.

Looking at assets across wealth groups, villages, and irrigation schemes, natural and financial capital displayed clear differences across all analyses. More precisely, natural capital in form land owned by a HH was significantly different: across villages, across schemes as well as between the high income group and the middle and low-income group. Mkombozi-TS, Mboliboli village, and the high-income group owned the highest average number of acres, ranging between 5.7 and 9.6 acres respectively. The remaining farmers owned 1.8 acres at the most. The same holds for HHs' net income. Mkombozi-TS, Mboliboli, and the high-income group displayed a net income of >900€ per year as compared to Mlengi-IS, the middle-income group, and Itunundu village with a yearly net income between 400€ and 650€ (Table 3, 4, 5). This suggests that the number of acres owned has a positive effect on the net income of a household. Further, this indicates that despite different sample sizes for the schemes, farmers in Mboliboli who use Mkombozi-TS are generally better off than farmers in Itunundu who use Mlengi-IS.

Concluding, a typical HH in the study area consists of a married couple with a HH-size between 4 and 5 people. Most of the HH heads are male with an average age of about 42 years and only primary education. Most of the HHs owned land, only few owned livestock;

however, the number of acres owned seems to increase with an increase in HHs' net income. Moreover, stated to be less well-off as compared to five years ago. Only about 30 percent of farmers stated to have sufficient income during the last year. However, when looking at the wealth groups, income sufficiency varies between 22 percent of the poorest farmers and 54 percent of the richest farmers (Table 3). Accordingly, also 50 percent of all HHs took on a loan, either as a precaution against hunger, to access non-local markets to sell their paddy, to secure and improve paddy production, or to invest in petty business. In order to get a better understanding of HHs' income sources, the next section focuses on HHs' activities, that is, the income shares which contributed to HHs' total gross income.

5.3.2 Households' Activities and Dependency on Irrigation

Households have different strategies to generate income, depending on what kind of assets they can access and how they are able to combine them. Thus, we look at how farmers generate income and how important income from irrigation is in that context. Hence, we look at how farmers' total gross income is comprised. Total gross income was separated in non-farm income, environmental income, and farm-income. Farm-income was further divided in income from paddy production and income from livestock, because their shares displayed great differences. In case of this study, income from paddy was calculated as paddy harvested times the price the paddy was sold for. For farmers who did not sell their paddy, an average price out of all prices was calculated. Further, income from irrigation is identical to the income from paddy, because irrigated paddy is the main cultivated crop and only three farmers cultivated maize besides paddy.

RQ6: What are HHs' main income activities and how do farmers in the study area adapt to the formalization of the communal irrigation regime?

5.3.2.1 Income shares by wealth groups

Looking at the income shares according to wealth groups (Table 6), we can see some overall trends as well as some group-typical trends. Firstly, we shall look at how income shares from the farm differ across wealth groups. All interviewed farmers get their main income share almost solely from paddy cultivation. Yet, the middle-income group has the biggest share (77%), followed by the low-income group (73%), and the high-income group (69%); the latter displayed significant differences towards the middle and the low-income group. The income share from the environment, respectively from firewood collection, decreases from the low to

the high-income group with significant differences between the low-income and the other two groups (Table 6). In contrast, the income share from non-farm activities increases from the low to the high-income group with significant differences between the high-income and the other two groups. The share of total gross costs decreases with increasing income. While in the low-income group the total gross costs account for a third of the income share, in the middle and high-income group, they only account for about a fifth.

Table 6: Sources of HH income shares by wealth groups (%), Iringa Rural district, Tanzania, 2013

| Wealth groups | | Low (N=26) | Middle (N=27) | High (N=23) | Weighted sample mean (N=76) |
|---|-------------------------------|-----------------------|------------------------|------------------------|-----------------------------------|
| Income share | | | | | |
| Farm income* | Paddy* | 74 ^b | 78 ^a | 74 ^a | 75 |
| | Livestock | 0 | < 1 | < 1 | < 1 |
| Environmental income* | Firewood* | 18 ^b | 11 ^a | 3 ^a | 11 |
| Non-farm income* | Land let & petty business* | 8 ^b | 11 ^b | 22 ^a | 13 |
| Total % | | 100 | 100 | 100 | 100 |
| Total gross income €/year* | | 284€ ^b | 597€ ^b | 1973€ ^a | 906€ |
| Total gross costs/year € (% of total gross income)* | | 82€ (29) ^b | 112€ (19) ^b | 316€ (16) ^a | 163€ (21) |

*a, b: different letters between wealth groups indicate significant differences of income shares in absolute numbers according to *Tukey-Kramer HSD* test, confidence quantile: $q^* = 2.39$, Alpha 0.05, $P \leq 0.1$.
1€ = 2140 TSh.

Looking at trends within wealth groups, we can see that the low-income group depended the most on farm income in form of paddy cultivation (74%) followed by environmental income in form of firewood collected from the forest (18%), and least on non-farm income from renting out land or running a petty business (8%). Similar to the low-income group, the middle-income group was most dependent on paddy cultivation (78%). Yet, environmental income and non-farm income represented equal shares (11%). The high-income group was as dependent on paddy cultivation (74%) as the low-income group. In contrast to the other two wealth groups, for the high-income group, non-farm incomes (22%) represented a bigger share of the gross income than the environmental incomes (3%) from firewood collection. However, income from paddy represented still the highest income share (Table 6).

Thus, we can see that with increasing income, the dependency on farm and environmental income decreases, whereas the dependency on non-farm income increases. In other words, HHs with higher income tend to diversify their livelihoods towards more non-farming activities, whereas as poorer HHs focus more on farming activities. However, all farmers still pursue an overall agricultural livelihood strategy, regardless the wealth group they belong to.

5.3.2.2 Income shares by villages

When looking at income shares by villages (Table 7), we see that farmers in both villages are most dependent on farm income, whereas environmental and non-farm income only contribute a minor share. Taking a closer look at the farm income, we see that farmers in both villages are most dependent on farm-income from paddy cultivation. Moreover, the income share from paddy in Mboliboli is significantly higher than the one in Itunundu. The income share from livestock however, is insignificantly low in both villages (Table 7).

Moreover, farmers in both villages depended very little on environmental income in form of firewood (8% and 6% respectively). Yet, farmers in Itunundu got 28 percent of their gross income from non-farm activities, whereas farmers in Mboliboli only got 14 percent (Table 7). Thus, despite a higher absolute total gross income, farmers in Mboliboli seem to focus more on farm activities than on non-farm activities. One reason may be the location of the village and thus, the rather limited possibilities of income diversification through non-farm activities.

Table 7: Sources of HH income shares by villages (%), Iringa Rural district, Tanzania, 2013

| Villages | | Itunundu (N=39*) | Mboliboli (N=40) | Weighted sample mean (N=79*) |
|--|------------------------------|----------------------|-----------------------|------------------------------------|
| Income share | | | | |
| Farm income* | Paddy* | 63 ^b | 80 ^a | 72 |
| | Livestock | 1.5 | < 1 | 1 |
| Environmental income | Firewood | 8 | 6 | 7 |
| Non-farm income | Land let & petty business | 28 | 14 | 21 |
| Total % | | 100 | 100 | 100 |
| Total gross income €/year | | 736€ | 1162€ | 952€ |
| Total gross costs/year € (% of total gross income)* | | 62€ (8) ^b | 253€(22) ^a | 159€(15) |

*Exclusion of landless HH.

*a, b: different letters indicate significant differences between villages in absolute numbers according to *Tukey-Kramer HSD* test, confidence quantile: $q^* = 1.99$, Alpha 0.05, $P \leq 0.028$. 1€ = 2140 TSh.

Indeed, both villages are rather isolated, Mboliboli is, however, even further away from the main bus route and has even worse market access. The higher total gross income may be explained by the higher number of rich landowning farmers living in Mboliboli than in Itunundu. These farmers also own more land and thus, tend to be able to rent out more land to generate non-farm income. However, that is not the case, either because farmers lend the land to relatives without charging rent or simply do not cultivate it.

Summing up, farmers in Mboliboli have a higher mean gross income than farmers in Itunundu. Yet, farmers' main income shares in both villages come from the farm. For the remaining shares, in Itunundu, farmers rely more on non-farm activities than on income from the environment, while in Mboliboli it is the opposite.

5.3.2.3 Income shares by irrigation schemes

Looking at income shares according to irrigation schemes, we can see the overall trend of farm income from paddy cultivation as being the main income share of HHs in both schemes (Table 8). Yet, in Mlenge-IS, environmental income shares from firewood are higher than the ones from non-farm income, while it is the opposite in Mkombozi-TS. Total gross income is significantly higher in Mkombozi-TS. Thus, these trends support richer farmers' tendency to diversify their incomes and move from farm to non-farm income.

Moreover, when comparing the trends of the schemes with the ones in the villages, we can see that the income shares of farmers within Mkombozi-TS resemble the ones of Mboliboli village (Table 7, 8). Income shares in Mlenge-IS rather show reverse tendencies of the ones in Itunundu village (Table 7, 8), but due to the small sample size it is unclear how representative these income shares are.

However, following Ellis' (2000a) classification of different types of livelihood strategies, the diversification patterns of the different wealth groups (Table 6) display tendencies of agricultural intensification, extensification, and livelihood diversification. The richer the HHs, the more non-farm income they tended to seek. Thus, one could argue that they tend to extensify their agricultural livelihood strategy. If that is the case, the agricultural productivity should decrease with increasing income. Yet, the agricultural productivity is increasing with increasing income. This suggests that the wealthier farmers are not extensifying their agricultural livelihood strategy, but rather start to diversify their livelihood strategies to create

additional income sources. However, the poorest HHs seemed to mainly rely on farming activities and hence, rather intensify their agricultural livelihood strategy.

Table 8: Sources of HH income shares by irrigation schemes (%), Iringa Rural district, Tanzania, 2013

| Income share | Irrigation schemes | Mlenge semi-improved (N=21) | Mkombozi traditional (N=54) | Weighted sample mean (N=75*) |
|--|---------------------------|-----------------------------|-----------------------------|------------------------------|
| Farm income | Paddy | 79 | 74 | 75 |
| | Livestock | < 1 | < 1 | < 1 |
| Environmental income | Firewood | 12 | 6 | 8 |
| Non-farm income | Land let & petty business | 9 | 20 | 17 |
| Total % | | 100 | 100 | 100 |
| Total gross income €/year* | | 473€ ^b | 1078€ ^a | 908€ |
| Total gross costs/year € (% of total gross income) | | 70€(15) | 199€(18) | 163€(17) |

*Exclusion of three HHs who used both schemes.

*a, b: different letters indicate significant difference between schemes according to *Tukey-Kramer HSD* test, confidence quantile: $q^* = 1.99$, Alpha 0.05, $P = 0.03$. 1€ = 2140 TSh.

The middle-income group got an equal share from environmental and non-farm income (Table 6). Thus, one could argue that they tended to diversify their livelihood strategy to not only rely on farm income. However, the most important income share for all farmers is first and foremost income from paddy cultivation. Thus, although one can observe trends of diversification, farmers still have an overall agricultural livelihood strategy and they highly depend on irrigation.

Looking at farmers' assets and activities across wealth groups, villages, and irrigation schemes, we observe two overall patterns. First and foremost, access to natural capital in form of irrigated land is the most important factor for farmers' livelihoods. Indeed, farmers' income shares reflect its importance: all analyses display that farmers' main income share comes from farming activities in general and from paddy cultivation in particular (>63%). Thus, all farmers have an overall agricultural livelihood strategy, which highly depends on irrigation. Secondly, there is an overall pattern that farmers in Mboliboli village, and farmers using Mkombozi-TS have more natural capital as well as income than farmers in Itunundu village, and farmers using Mlenge-IS. Thus, more natural capital seems to lead to more

income. Yet, the data did not allow determining whether the location or the scheme is the decisive factor for owning more land and having a higher income.

However, the data displayed very clearly the social and economic heterogeneity of communities, as also suggested by critical institutionalists and discussed in section 5.2 (Clever 2007). The formalization of institutions reinforces power struggles and often excludes poorer farmers from rule-making and thus, from protecting their interests and from securing their asset access (see section 5.3.1.1). Thus, farmers have very different socio-economic foundations for their income generation. Indeed, income across wealth groups displayed significant differences between the high-income group and the middle and low-income group respectively. Yet, regardless the income-group, farmers still have an overall agricultural livelihood strategy and they highly depend on irrigation.

This relatively high dependency on irrigation, together with strong restrictions on irrigation (see section 5.1), may put a high risk on farmers and the environment. Crop failures due to pests or paddy diseases may threaten the main livelihood of the majority of farmers and thus, may strongly increase the vulnerability of an entire community. Indeed, during harvesting times, farmers in both schemes struggle with pest birds, such as *Quelea quelea L.*, who feed on drying paddy seeds. However, as for now, the political and institutional contexts surrounding the farmers tend to increase also the environment's vulnerability. Namely, the NAWAPO requests the formalization of irrigation regimes. Yet, due to lacking criteria for water-allocation within the economic sector and physical water scarcity, the formalization of the irrigation regimes leads to restrictions on water access. These restrictions expose farmers to higher competition over water, and in Mlenge-IS also over land. Thus, farmers illegally cultivate at the river banks which may increase sedimentation in the Little Ruaha River and thus, not only reduce its water quality, but also farmers' main resource for paddy production. Further forest encroachment through charcoal production and firewood collection may add to this.

5.4 Outcomes of the Regime's Formalization

RQ7: Does the formalization of the irrigation regime and the dependency on irrigation lead to improved livelihood security and sustainable resource use?

Recalling the discussion on the interlinking of institutions across government levels (see also section 5.1), we found that the formalization of the irrigation regimes leads to physical and institutional restrictions of farmers' water access as well as to a change of the irrigation regime. The main physical restrictions are the water intakes. The improved water intake of Mlinge semi-improved scheme allows regulating water flows to improve water distribution. Yet, the intake also allows decreasing the amount of water which flows into the scheme and thus, leads to higher competition among farmers. Indeed, looking at the sustainable livelihoods analysis (section 5.3), the findings show that farmers in the semi-improved scheme own significantly less land and have less income than farmers in the traditional scheme. Thus, one can argue that the improvement of Mlinge-IS's water intake actually decreased farmers' water access while exposing them to more competition. Thus, farmers in the semi-improved scheme may have become more vulnerable, while most of the farmers in the traditional scheme may benefit from unregulated and thus, non-restricted amounts of water flowing into the scheme.

Yet, when looking at the agricultural productivity in the two schemes, farmers in the semi-improved scheme have slightly higher yields per acre than farmers in the traditional scheme. This suggests that although the amount of water in the semi-improved scheme is restricted, the use and distribution of water is more efficient than in the traditional scheme. Hence, access to natural capital – acres owned – seems to be the limiting factor for income generation in the semi-improved scheme rather than the agricultural productivity per acre.

Evaluating the institutional restrictions and their effects on the irrigation regime, we look again at the social inequalities in irrigation management which came to the surface during the analysis of the institutional characteristics of the two schemes (section 5.2). The formalization process broke up the once informal irrigation regimes, but did not completely replace the former institutions. Yet, altering an irrigation regime always leads to a reorganization of actors' institutions and thus, of the costs and benefits of irrigation. With the reorganization and restriction of heterogeneous communities, power relations come into play. Thus, some actors are granted agency to change institutions which hence, reflect and protect their interests, while other actors are excluded from this process. Findings from section 5.2 indicate

that the local elites, such as the IC, as well as external authorities, such as the RBWO, make the rules, while the poorer farmers are excluded and further marginalised. For example, the IC of Itunundu helps farmers to solve conflicts over water access only if they get paid. Yet, poorer farmers often cannot afford to pay the IC and thus, have to solve their conflicts themselves. If their 'opponent' is much wealthier and thus more powerful, the poorer farmers are likely to lose the case. Thus, they may not only have to deal with potential sanctions, but may also have insufficient access to water for irrigating their paddy. Being the ones who depend the most on income from paddy cultivation, this may seriously threaten their livelihoods in the longer term. Thus, for the already poor farmers, formalization of the irrigation regime decreases the socio-economic sustainability and increases their economic vulnerability.

However, irrigated paddies have a high potential for agricultural intensification as farmers in the study area use very little additional inputs and only simple working tools. Yet, farmers face a dilemma between investing capital in intensifying single crop production and reducing risk and vulnerability. Intensifying paddy production implies reducing of agricultural diversity and investment of financial capital in and dependence on agricultural inputs. Farmers need to purchase these inputs from the free market at a certain point in time. Hence, they are not able to use other capital than their financial capital to access these inputs. This also means that farmers need to have financial capital at a certain point in time. If they are not able to generate financial capital themselves, farmers need to be able to take on loans; accessing loans depends on farmers' social capital and further adds to the risk and their economic vulnerability. Moreover, relying on the market exposes farmers to price fluctuations and also to competition with powerful and community-external commercial actors of the public and private sector. Thus, farmers risk becoming economically dependent on external actors and thus, economically more vulnerable. Farmers' physical distance to the market adds to their vulnerability due to the dependence on and potential exploitation by traders and middle men. Thus, farmers need to balance risk-increasing intensification of paddy production and market dependence with risk-reducing diversification of (subsistence) production. Recalling the influential power of policies and institutions, politicians and development programmes need to take this dilemma into account when creating incentives for farmers' agricultural investments.

Moving on to the outcomes for the environment, the formalization of the irrigation regime and the corresponding restrictions on water access led to illegal cultivation on the river banks. Thus, the environment's sustainability rather decreases; however, in the long-term, complete formalization and implementation of protection mechanisms may ensure and possibly increase its sustainability.

Summing up, irrigation contributes to farmers' food security as income from paddy production accounts for around 70 percent of farmers' livelihoods. Yet, the nature of the irrigation regime formalization reduces socio-economic sustainability. Formal institutions give power to local elites while excluding poorer farmers from decision-making and reduce their asset access. Formal institutions further reduce water access in the semi-improved scheme and thus, increase competition over water among farmers. Dependence on a single irrigated crop and difficult market access reduces farmers' capability to cope with crop failures, and increases their vulnerability to economic exploitation by middle men. Compensating these challenges by taking up loans, as done by 50 percent of the farmers, increases the economic vulnerability even more. Thus, the formalization of the irrigation regimes and the dependency on a single irrigated crop makes farmers' agricultural livelihood strategy a rather risky and unsustainable one; at least at this stage of formalization.

6 Conclusions and Future Recommendations

This chapter concludes on the research done and reflects on theory and provides some future recommendations for policy and research.

Using the framework for analysing natural resource regimes, the study's first objective focused on cross-level relations between political actors and institutions in the irrigation sector of Iringa Rural district (section 3.1). The investigation of water allocation in the Great Ruaha basin revealed that the RBWO follows the priorities set by the NAWAPO. Yet, water allocation between hydropower and irrigation lacks clear allocation-criteria. The lack of clear allocation criteria facilitates the prioritization of hydropower over irrigation: the RBWO restricts farmers' water access for irrigation to the rainy season in order to ensure sufficient water for the hydropower plant all year round. This becomes critical since the Little Ruaha River only provides sufficient amounts of water for hydropower generation and irrigation during the rainy season. Thus, farmers face physical water scarcity during the dry season and high competition during the rainy season and are further economically and politically marginalised (section 5.1.1).

Further, the investigation of the irrigation infrastructure in place showed that farmers' economic marginalisation is reinforced by poor irrigation infrastructure. Mlenge-IS has a constructed water intake and a few kilometres of constructed canal, whereas Mkombozi-TS's intake consists of sandbags, branches, and rocks. Thus, the regulation of water flows in Mlenge-IS is better than in Mkombozi-TS, yet, many farmers are still left with too little water or flooded farms which hampers their paddy cultivation (section 5.1.1).

To complete the study's first objective, we looked at the political actors who both define the irrigation regime and the processes of regime formalization and how they interlink. The formalization process followed a clear top-down approach governed by a network of political actors and their institutions. On regional level the RBWO, the ZIU, and the DC, are mainly involved in water permit application processes and scheme development and are in direct contact with the irrigators' organisations of the two schemes and the village irrigation committees on local level (5.1.2). The latter actors are mainly involved in rule-making, monitoring, and conflict solving of the two schemes.

Taking on a bottom-up approach, the second objective focused on the relations between farmers and irrigation institutions. More specifically, we investigated important institutional characteristics of the two irrigation schemes and the differences between them (section 5.2), based on a theoretical discussion of mainstream and critical institutionalist views (section 3.2). Institutions of Mlenge-IS displayed a higher level of formality than institutions of Mkombozi-TS. Yet, irrigation regimes in both schemes emerged as a landscape of institutional bricolage, rather than as a clear set of consequential and mutually dependent rules. Thus, power relations and inequalities permeate both regimes and often lead to further exclusion of already poorer farmers. The irrigation regime of Mlenge-IS is characterized by formal boundaries and water-access rules and merely informal water-use rules; a mix of formal and informal institutions governs monitoring and conflict solving. Similar to Mlenge-IS, Mkombozi-TS has clear and formal access rules; yet, the unconstructed water intake of the scheme does not allow implementation. Farm boundaries are officially and clearly defined but in practice they are contested due to a former land and scheme-ownership conflict between the farmers and a prison. Water-use rules are merely informal as is monitoring and conflict solving. Concluding, the level of formalization is higher in the semi-improved scheme than in the traditional regime. Yet, the water use-rules, which determine the quality of irrigation within the schemes, are still merely informal and not always fair to all farmers.

Farmers' social and economic inequalities were thus the focus of the study's third objective, which examined the HHs economic condition with help of the sustainable livelihoods approach (section 3.3). The fifth and sixth research question identified HHs' assets and activities by wealth groups, villages, and irrigation schemes. HHs mostly draw on human, natural, and social capital, whereas they often lack physical and financial capital. Their main income share comes from the farm, more specifically from paddy cultivation. Thus, HHs have an overall agricultural livelihood strategy and they highly depend on irrigation (section 5.3).

The overall outcomes of the formalization of the irrigation regime are two-fold. On the one hand, the formalization process breaks up the once informal irrigation regime, but does not completely replace the former institutions. Thus, the formalization of the irrigation regime decreases farmers' water access and the socio-economic sustainability, while increasing competition and thus, their economic vulnerability. Farmers take on loans in order to be able to access town markets to sell their crops or make provisions against hunger. On the other hand, the general political focus on irrigation-improvement implies a high potential for

agricultural intensification and income generation for farmers. However, focussing on intensifying the production of a single crop, such as irrigated paddy, reduces the diversity of livelihood strategies and thus, comes with a higher risk. Looking at the outcomes for the environment, the incomplete formal irrigation regimes as well as the restrictions on water access lead to illegal crop cultivation at the river banks. This threatens the sustainability of the water resource rather than increasing it. However, the formalization of the irrigation regime together with improved water allocation between hydropower and irrigation may ensure and possibly increase its sustainability in the longer term.

Theoretical reflections

Throughout the analysis, both mainstream and critical institutionalism provided valuable explanations and guidance. The rather straight forward views of mainstream institutionalism in general, and Ostrom's design principles in particular, were a helpful tool in the field as well as for the analysis, especially because of their clarity and contested simplicity. Critical institutionalism gave detailed insight into participation issues and social agency within heterogeneous communities and communal resource management. More specifically, it offered valuable explanations as to why poorer farmers are often excluded from decision-making processes and thus, suffer from reduced resource access and further marginalisation.

Yet, one can criticize critical institutionalists' tendency to get lost in the nitty-gritty details of social agency. On the one hand, this reduces the practicality of this approach and may keep researchers from using it. On the other hand, focussing intensely on the details of social agency makes researchers liable to ignore the 'bigger picture' as well as sometimes purely rational reasons as to why people behave the way they do. Indeed, in case of this study, one could argue that the lack of participation in the formalization process of the irrigation regime is mainly caused by a general lack of economic incentives. Yet, analysing the regime with a critical institutionalists view revealed a different picture. Not all farmers lack economic incentives; rather weak institutions and power relations allow the wealthier farmers to benefit, while marginalising the already poorer farmers. Thus, critical institutionalism has its strength in in-depth and community-internal explanations of social agency. Mainstream institutionalism and particularly Ostrom's design principles provide an overall framework for analysing local communities and are thus, the foundation for more critical and in-depth analysis. Thus, the key is to remain sensitive to both mainstream and critical institutionalism.

Reflections on Tanzania's water policy and future recommendations

Having discussed the impacts of Tanzania's water policy from basin to HH-level, it is time to take a step back and reflect on the policy's general value. Despite all criticism, one has to acknowledge that the water policy decentralizes power by delegating responsibility to the local level and by involving local people in irrigation management. With the general focus on irrigation improvement, the irrigation schemes have been improved and have contributed to more efficient and more equal water distribution. However, the policy has drawbacks as well. First, lacking criteria for basin-wide water allocation between the different water sectors and users, which lead to the economic marginalisation of small-scale farmers. Second, the decentralization of power breaks up former management structures, overrides or sidelines local institutions, and revives power struggles – within and across government levels as well as among economic and political actors.

On local level this leads to marginalisation of irrigators through a ban on irrigation during the dry season. And within communities, the reinforced power relations often lead to exclusion of the already poorer farmers from decision-making and from sufficient resource access. Thus, this further contradicts the country's purported legal pluralism: recognizing local customary laws. However, on basin and sub-basin level this leads, together with a lack of water-allocation criteria, to prioritizing of hydropower generation over irrigation. Indeed, as discussed in section 5.2.7, Van Koppen and Tarimo (2014) found that in the Wami/Ruvu basin in Tanzania, 89 percent of the water was re-allocated to 30 commercial users, while only 11 percent was allocated to 930 small-scale users. Thus, if the formalization of the irrigation regime in the study area leads to reduced water access for small-scale farmers in order to serve the commercial water users in the area, the implementation of the current water policy creates even new water-allocation problems. Hence, researchers need to further investigate the water allocation between hydropower and irrigation on basin and sub-basin level as well as between small-scale and large-scale users.

With increasing water scarcity and further development, Tanzania's politicians see an undisputed need to somehow get an overview and control water distribution and extractions in the country as well as to finance this development. As for now, the state introduced water-use fees and fees for water permits for all water users to account for this. Yet, the state's calculative rationality contradicts farmers' rather social and normative rationality on local levels. Farmers' in the study area did not understand the need for the introduction of water use

fees, arguing that water is a 'gift from God'. Indeed, charging the poorest for water use is questionable; yet, farmers' cost shares from water use fees account for about 10 percent of farmers' total costs and for about two percent of farmers' net-income. Thus, charging farmers with water use fees can, objectively, not be seen as state exploitation. Yet, if the introduction of fees for small-scale irrigation serves the purpose of controlling, reducing, and then prioritizing water allocation for other large-scale commercial uses, as indicated by Van Koppen and Tarimo (2014), farmers' scepticism towards these institutions is justified.

Moreover, one can question how well the state institutions for water management in general and for irrigation management in particular fit the local conditions. In the study area, there are institutional overlaps between the village irrigation committees and the state introduced irrigators' organisations and thus, between administrative boundaries of villages and schemes. The findings from the institutional analysis of the semi-improved scheme suggest that despite the introduction of the irrigators' organisations almost 10 years ago, irrigation management is still carried out the same as before the introduction of state institutions: mainly informal and by the village irrigation committees. Thus, continuing this lengthy implementation of the current water policy, which often sidelines the local institutions, is questionable. However, the country's legal pluralism has the potential to allow for a more flexible policy. Thus, instead of formalizing the whole irrigation sector, rather keep the formal structures on basin level, but define clearer criteria for and stricter monitoring of water allocation, including better infrastructures to allow regulating of water access and flow into irrigation schemes. Yet, make use of working informal institutions on scheme level and leave the actual management of irrigation schemes to the local communities, while the district extension services could help to improve the efficiency of water use. This could help to ensure equal water access for small-scale as well as for large-scale users while getting an overview and control over the water resources.

Finally, we take a look at the potential future development of peasant societies under the regime of the current water policy. The local communities are economically and socially heterogeneous: a few farmers own significantly more land than the majority of the population which allows them to accumulate more capital than the remaining farmers. This wealthy minority also employs other farmers and thus, creates a labour market, especially for poorer farmers. If this trend continuous, it may lead to a group of workers and a group of capital owning farmers. Recalling the discussion in section 3.3, the findings indicate a societal

development of the communities towards differentiation rather than towards consolidation. However, further social differentiation requires access to resources as well as further accumulation of capital. Yet, looking at how water is allocated on higher government levels – more water allocated to commercial users than to small-scale users – peasant economies on local level may have reduced water access. These restrictions may reach an extent which does not allow further capital accumulation for the wealthier farmers.

Indeed, if the tendency of allocating more water to commercial users holds true in the future, the state may be accused for ‘green grabbing’: the appropriation of natural resources by restructuring rules over water access to serve ‘green ends’ (Fairhead et al. 2012). In case of this study, this means reducing farmers’ water access to ensure ecosystem services of the river. One could take this even further and claim that the state does not only ‘grab’ water to ensure ecosystem services but also, or foremost, to prioritize commercial users and thus, threaten small-scale farmers’ livelihoods. Yet, these are rather harsh claims. Nonetheless, they indicate the potential threats for small-scale farmers if the policy implementation continues in the future as it has done up to now.

Concluding, Tanzania faces a dilemma: allocating water for small-scale irrigation agriculture to reduce poverty while at the same time allocating water for further industrial development. Yet, the country’s legal pluralism leaves enough space to close this gap, but it will remain if politicians do not address the existing water allocation issues on basin level and the sidelining of informal and local institutions on scheme and village level. Thus, this study recommends further investigation of the basin-wide water allocation between different water sectors in general, and within the economic sector and between small-scale and large-scale users in particular. Moreover, Tanzania needs to define clearer criteria for and stricter monitoring of water allocation while leaving room for more community driven local irrigation management within schemes.

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Appendix I

QUESTIONNAIRE FOR THE HOUSEHOLD SURVEY

| | |
|--------------------------|----------------|
| 01. Country: | Date |
| 02. Village: | Starting time |
| 03. Questionnaire number | Finishing time |

| | | I1 ¹⁾ | I2 ²⁾ | I3 | I4a ³⁾ | I4b ⁴⁾ | I5 ⁵⁾ |
|------|----------------|------------------|------------------|------------|-------------------|-----------------------|------------------|
| ID | Position in HH | Sex | Marital status | Age (yrs.) | Education | Other skills training | Main occupation |
| 1sex | Head of HH | | | | | | |
| 2sex | Spouse | | | | | | |

1) Codes: 1=male; 2=female

2) Codes: 1= married; 2= divorced; 3= widowed; 4=single;

3) Codes: 1= no formal education; 2=primary; 3=secondary; 4=higher education (college, university or similar)

4) Codes= 1=farmer; 2=prison officer; 3=teacher; 4 = driver; 5= tailor; 6= carpentry; 7= construction worker

5) Codes: 1=farmer; 2=carpentry3=construction worker;

Introduction: HISTORY

H1 To which ethnic group/tribe do you belong? _____

H2 Are you born in this village?

Yes If yes, move to A1

No If no, move to H3

Codes: 1= yes; 2 = no

H3 When did you migrate?

From where? _____

Why?

Codes: 1 = family; 2 = marriage; 3 = work; 4 = agriculture

To get a better understanding of your daily life, I would like to ask you some things about the composition of your house hold.

SECTION A: Human, Physical, Social, and Financial Assets & other Income sources

The aim of this section is to map out household characteristics, assets and ownership.

I. HUMAN ASSETS:LABOUR

Household characteristics and composition

A1. Please indicate the number of permanent household members in each group:

| Age group | Male | Female | Work on farm hours per day | Work on farm days per week |
|-----------|------|--------|----------------------------|----------------------------|
| 0 to 15 | | | | |
| 16 to 45 | | | | |
| 46 to 60 | | | | |
| Above 60 | | | | |

A2. Labour force: male female dependent

A3. Did you ever work outside the village?

No

If that applies go to A5

Yes, how many years did you work off-farm in total?

please specify activity _____

A4. What is your experience/what did you learn/did you change something after?

II. PHYSICAL ASSETS

| Habitation | | |
|------------|--|--|
| A5 | Material roof <i>Codes: 1 = straw mats; 2= iron sheets</i> | |
| A6 | Material used in construction of walls of the main house? <i>Code: 1= burned bricks 2= mud bricks; 3= sticks with mud plastering;</i> | |
| A7 | What is the main source of potable water used by the household <i>Code: 1=personal tap; 2=public tap;</i> | |

| | | | | |
|----|--|--------|--------|--------|
| A8 | What is the most important source(s) of energy for | Rank 1 | Rank 2 | Rank 3 |
| | Cooking? ¹⁾ | | | |
| | Light? ²⁾ | | | |
| | <i>Please rank your answer in the order of importance²⁾</i> | | | |

Code: 1= fuel wood; 2= charcoal; 3= gas; 4= electricity; 5=bought fuel wood;

Code: 1= battery; 2= kerosene; 3= solar; 4= electricity (generator)

A9. Please indicate the number of implements and other large household items that are owned or rented by the household.

| No | Assets | Quantity ¹⁾ | Owned ²⁾ |
|----|--|------------------------|---------------------|
| 1 | House(s) (for living in) | | |
| 2 | Radio | | |
| 3 | Telephone | | |
| 4 | Bicycle | | |
| 5 | Motorbike | | |
| 6 | Other | | |
| | Agricultural implements and drafts animals | | |
| 7 | Hoes | | |
| 8 | Scythe (Sense) | | |
| 9 | Pangas (machete) | | |
| 10 | Axes | | |
| 11 | Donkey | | |
| 12 | Oxen | | |
| 13 | Tractor/ power tiller | | |

Measure in number. If the HH does not have access to the item, write 0.

III. SOCIAL ASSETS

A10. How do you rate your household's relationship with the following?

| No | | 1 Very bad | 2 Bad | 3 Fair | 4 Good | 5 Very good |
|----|--|------------|-------|--------|--------|-------------|
| 1 | People from other tribes | | | | | |
| 2 | NGO workers | | | | | |
| 3 | IO board/basin committee | | | | | |
| 4 | In-migrants/people who rent land for farming | | | | | |
| 5 | Neighbors | | | | | |
| 6 | Other irrigators | | | | | |
| 7 | Farmers/pastoralists | | | | | |
| 8 | Village council/leaders | | | | | |
| 9 | District officials | | | | | |
| 10 | River Basin authorities | | | | | |

A11. Does any member of your household belong to the following groups?

| No | Groups | Member ¹⁾ | Function in the group ²⁾ |
|----|-------------------------------|----------------------|-------------------------------------|
| 1 | Farm groups | | |
| 2 | Village committee | | |
| 3 | Local NGOs | | |
| 4 | Traditional council | | |
| 5 | Local political group | | |
| 6 | Religious group | | |
| 7 | Credit union | | |
| 8. | Savings group | | |
| 9 | IO/basin committee | | |
| 10 | Others (<i>pl. specify</i>) | | |

Codes: 1) 1= leader; 2=ordinary member 99=does not exist

2) 1= Basin committee; 2= Savings group; 3= traditional council; 4= village council except BC; 5= new IO; 6= political party; 7= NGO member

IV. FINACIAL ASSETS & OTHER INCOME SOURCES

A12. Has the household's income over the past 12 months been sufficient to cover what you consider to be the needs of your HH?

Codes: 1= yes; 2= reasonable; 3= no

A13. In difficult times, did the HH help friends or neighbors over the past 12 months, or did the HH receive some help from neighbors, friends, relatives, banks? (Cash, micro credit, or in kind payment)

| No | Principal purpose | Received ¹⁾ | Given ¹⁾ | If 'yes', please indicate the amount received (Tsh) |
|----|--------------------------|------------------------|---------------------|---|
| 1 | Labour (no of people) | | | |
| 2 | Food | | | |
| 3 | Non-farm (transport etc) | | | |
| 4 | Money | | | |
| 5 | Existing loans | | | |
| 6 | Interest rate of loan | | | |

Code: 1=Yes; 2=No

A14. How well-off is your household compared to the situation 5 years ago?

Codes: 1=worse-off; 2=about the same; 3=better-off

A14a. Why?

Codes: 1= high input costs, low output price (rice); 2 =age (can't work as much); 3= agricultural yields; 4 =less children to feed; 5= single parent; 6= has partner now-> more labour force

A15. Has your household been food-insecure the last year? Yes/no
If yes, when (months/year)? _____

A16. Does your HH take any actions to prepare for hunger? _____

Codes: 1= food storage; 2= ration food/budgeting; 3= exchange rice with maize; 4= borrow food; 5= take loan; 6= work as labour force/sell pombe/firewood; 7= cultivate maize for dry season; 8= plant early to harvest early

A17. Has your HH faced any major income shortfalls, unexpected large expenditures, or other challenges during the last 12 months? Yes/no

If yes, please complete the table

| No | Serious event | How severe? | How did you cope with the income loss or costs? |
|----|---|-------------|---|
| 1 | Serious crop failure | | |
| 2 | Death/serious illness in family (of productive age group) | | |
| 3 | Loss of irrigated land | | |
| 4 | Loss of waged employment | | |
| 5 | Volatile prices | | |
| 6 | Difficult market access | | |

Codes: 1= somewhat severe; 2= severe; 3= very severe; 99(.)= not relevant

A18. Which services do you get from the river? _____

A19. How often do you fish? (fishing/week) _____

A19a. For which purpose? Own use for selling
Codes: 1= own use; 2= selling

A20. How important is fishing for the HH?

| season | 1 Not important/not available | 2 Somewhat important | 3 Medium important | 4 Important | 5 Very important |
|-----------------------|-------------------------------|----------------------|--------------------|-------------|------------------|
| Cropping season (wet) | | | | | |
| Off-season (dry) | | | | | |

Codes: 1=not important; 2= somewhat important; 3= medium important; 4= important; 5= very important

A21. Are you employed? If no, go to A23.

Codes: 1= yes; 2= no

A22. What is the average annual income from employment (inTsh)? _____

A23. Are you or any members of your HH involved in any type of business, and if so, what was the **net income** from that business last year?

| | Business 1 | Business 2 |
|--------------------------------|------------|------------|
| What is your type of business? | | |
| Net income (in Tsh) | | |

SECTION B: NATURAL ASSETS (Land, Livestock, Forest Use)**I. Land Use**

B1 Do you have land? How much land do you have (acres) and where? _____

Characteristics of your farm land in the **last 12 months**.

| Parcel No | Crop type ¹⁾ | Ownership (tenure) ²⁾ | Land conversion type ³⁾ | Area irrigated (ac) | Area non-irrigated (ac) | Labor ⁴⁾ | Input kg ⁵⁾ | Input price (Tsh) per kg | Total output (kg) | Sold (kg) local market | Price (Tsh) per kg | Storage (kg) | Sold where? ⁶⁾ | Machine input ⁷⁾ |
|-----------|-------------------------|----------------------------------|------------------------------------|---------------------|-------------------------|---------------------|------------------------|--------------------------|-------------------|------------------------|--------------------|--------------|---------------------------|-----------------------------|
| 1 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |

Codes: 1) 1= maize; 2= rice;

2) 1= HH; 2=

3) 1=farm; 2=forest;

4) 1= household; 2= hired;

5) 1= fertilizer; 2= pesticides; 3= hybrid seeds;

6) 1=local; 2=Iringa Town; 3=both local and town

7) 1=power tiller; 2=oxen; 3=tractor; 4=people

B2 Do prices differ throughout the season and if yes, how?

Code: 1= yes; 2= No

B3 Do you face any constraints regarding your agricultural production?

Codes: 1=poor working tools; 2= poor infrastructure; 3= water conflicts/blocking of canals; 4= boundary conflicts; 5= decrease of water level; 6= weeds/pests/other animals; 7= salinity; 8= unlevelled farms; 9= limited land; 10= expensive inputs; 11= farm flooded; 12= compacted soils (by cattle)

B4 Is it easier to get new land for irrigation agriculture today than five years ago?

| | | | |
|-------------------|--------------|---------------|-----------------------|
| 1. By inheritance | 2. By buying | 3. By renting | 4. By clearing forest |
| | | | |

Codes: 1=easier; 2=as before; 3=more difficult

B4a If you have marked 'more difficult' (3) in any of the above categories, why is it so? Please state the most important reason:

Codes: 1= expensive to buy, you only sell if you really have to; 2= population increase

B5 Have you had any conflicts over access to land for agriculture in the last five years?

Codes: 1=Yes; 2=No

B5a. If 'yes', how would you describe the seriousness of these conflicts?

| | | | | |
|------------|-------|----------------|--------|-------------|
| 1 Very low | 2 Low | 3 Intermediate | 4 High | 5 Very high |
| | | | | |

QUESTIONS FOR LANDLESS PEOPLE:

L1. Since when are you without own land?

Always

Since (year)

L2. How come that you do not have your own land? _____

I. LIVESTOCK

B6 What is the no of livestock/products that your household has sold, bought, slaughtered or lost in **the last 12 months**?

How do you feed your livestock?

| No | Livestock at start of the year | No | Product produced | Sold/ barter (in No or kg) | Price (Tsh/ animal/ kg/ liter) | For own use | Lost (died or theft) | Total number owned end of the year | Feed from Forest land (grazing or collected fodder) ¹⁾ | Feed from non- Forest land (grazing or collected fodder) ¹⁾ | Using crop residues ¹⁾ | Others (please specify) |
|----|--------------------------------|----|------------------|----------------------------|--------------------------------|-------------|----------------------|------------------------------------|---|--|-----------------------------------|-------------------------|
| 1 | Cattle | 1 | Live animal (no) | | | | | | | | | |
| | | 2 | Meat (kg) | | | | | | | | | |
| | | 3 | Milk (liters) | | | | | | | | | |
| | | 4 | Hide (kg) | | | | | | | | | |
| 2 | Goat | 5 | Live animal (no) | | | | | | | | | |
| | | 6 | Meat (kg) | | | | | | | | | |
| | | 7 | Milk (liters) | | | | | | | | | |
| 3 | Sheep | 8 | Live animal (no) | | | | | | | | | |
| | | 9 | Meat (kg) | | | | | | | | | |
| | | 10 | Milk (liters) | | | | | | | | | |
| 4 | Donkey | 11 | Live animal (no) | | | | | | | | | |
| | | 12 | Meat (kg) | | | | | | | | | |
| | | 13 | Milk (liters) | | | | | | | | | |
| 5 | Pig | 14 | Live animal (no) | | | | | | | | | |
| | | 15 | Meat (kg) | | | | | | | | | |
| 6 | Poultry | 16 | Live animal (no) | | | | | | | | | |
| | | 17 | Egg (kg) | | | | | | | | | |
| | | 18 | Meat (kg) | | | | | | | | | |
| 7 | Ducks | 19 | Live animal (No) | | | | | | | | | |
| | | 20 | Meat (kg) | | | | | | | | | |

1) 1= farm fields; 2= crop residues; 3= both

II. FOREST USE

B7 How far is it in **minutes** (walking) from your house to the edge of the nearest forest that you often use?

B8 Forest products by household: both for own use and sale over last 12 months

| | Main forest products | Forest type | Sex/age group ¹⁾ | Use ²⁾ | Price fuel wood per power tiller load |
|---|----------------------|-------------|-----------------------------|-------------------|---------------------------------------|
| 1 | Fuel wood | | | | |
| 2 | Poles & timber | | | | |
| 3 | Charcoal | | | | |
| 4 | Other NTFP | | | | |

Codes: 1= men; 2= women; 3= children; 4= mix

Codes: 1= own use; 2= for selling and own use

SECTION C: Institutions around Water Use & Distribution

INTRODUCTION/HISTORY OF IRRIGATION SYSTEM

C1 What kind of irrigation scheme do you use?

Codes: 1= Mlengi (semi-improved); 2= Mkombozi (traditional)

C2 Which canal do you use?

Codes: 1= main canal; 2= secondary canal; 3= tertiary canal; 4= small canals

C3 How would you rate your **access to and use of water** for irrigation today compared to five years ago?

| | | | | |
|----------------|-----------|------------|-------------|------------------|
| 1 Much reduced | 2 Reduced | 3 The same | 4 Increased | 5 Much increased |
| | | | | |

C6a. If 'reduced' or 'increased', what do you consider to be the most important factor(s) limiting your access to and use of water for irrigation today? If more than one, please rank up to the three most important factors.

| | |
|---|--|
| 1 | |
| 2 | |
| 3 | |

Codes: 1= competition/many users; 2= less rain; 3= many users plus less rain; 4= infrastructure of canal; 5= no proper use of water/catchment destruction

I. RULES INDICATING BOUNDARIES OF WATER RESOURCE AND COMMUNITY

| No | Statement | Strongly disagree | Disagree somewhat | fair | Agree somewhat | Strongly agree |
|----|---|-------------------|-------------------|------|----------------|----------------|
| C4 | Rules for water access are clearly defined | | | | | |
| C5 | Physical boundaries of the farm are clearly defined | | | | | |
| C6 | Rules for water use are clearly defined (seasons?) | | | | | |
| C7 | Rules for water access are fair | | | | | |
| C8 | Rules for water use are fair | | | | | |

II. CONGRUENCE OF INSTITUTIONS

C9 What duties do you have for the irrigation canal?

Code: 1=cleaning canals, slash grasses, remove sediments

C10 How much do you pay as an irrigating farmer? _____

C11 Is the fee you pay related to the amount of water you get, to the size of your farm or to other criteria? Yes/no

C12 Who is collecting the fee?

Codes: 1=BC; 2=village government; 3=people in behalf of BC; 4=VEO; 5=villagers

C13 What is the fee used for?

Codes: 1=maintenance of canal, excavator for cleaning; 2=maintenance plus Rufiji fees; 3=maintenance plus TANESCO

How do you rank the following statements?

| | Statement | Strongly disagree | Disagree somewhat | Fair | Agree somewhat | Strongly agree |
|-----|---|-------------------|-------------------|------|----------------|----------------|
| C14 | You get enough water to irrigate your crops | | | | | |
| C15 | Water distribution along the canal is fair | | | | | |
| C16 | People closer to intake get more water than people at tail end | | | | | |
| C17 | People take water without permission | | | | | |
| C18 | Duties you have are balanced with benefits from irrigation | | | | | |
| C19 | In times of scarcity, water is still fairly distributed among all users | | | | | |

III. THE ONES AFFECTED ARE ALSO ABLE TO MODIFY RULES

C20 Who is making the rules of accessing and using water?

Codes: 1=BC; 2=villagers; 3=villagers plus Rufiji; 4=village leaders; 5=district office

C21 Have you ever raised your voice in village meeting? If no, why?

C22 Do you have any water distribution agreements with your neighbouring farmers apart from official rules??

Codes: 1=yes, especially when water scarce; 2=no, rather conflicts than agreements because everybody wants water

C23 Is there regular monitoring of the irrigation scheme?

Codes: 1= yes; 2= no

IV. MONITORING DONE BY USERS

| | Statement | Strongly disagree | Disagree somewhat | Not sure | Agree somewhat | Strongly agree |
|-----|---|-------------------|-------------------|----------|----------------|----------------|
| C24 | Monitoring is done by influential villagers | | | | | |
| C25 | Monitoring is done in a fair way | | | | | |
| C26 | People respect monitors | | | | | |

V. GRADUATED SYSTEM OF SANCTIONS

| | Statement | Strongly disagree | Disagree somewhat | Not sure | Agree somewhat | Strongly agree |
|-----|--|-------------------|-------------------|----------|----------------|----------------|
| C27 | The sanction system is fair in relation to the offense | | | | | |
| C28 | The sanction system is fair to all users | | | | | |
| C29 | Sanctions reduce no. of violators | | | | | |

C30 Have people in the village ever violated irrigation rules?
Codes: 1= Yes; 2= No (if No, go to C48)

C31 If yes, have they been caught/ sanctioned?
Codes: 1= Yes; 2= No

C32 Have you complied with the sanctions?
Codes: 1= Yes; 2= No

C33 Have you ever violated rules?
Codes: 1= Yes; 2= No (if No, go to C51)

C34 Have you been caught/ sanctioned?
Codes: 1= Yes; 2= No

C35 Have you complied with the sanctions?
Codes: 1= Yes; 2= No

C36 Who is enforcing the sanctions? _____

Codes: 1=BC; 2=chair of BC; 3=village leaders; 4=VEO; 5=police

VI. LOW COST CONFLICT RESOLUTION

Please rank the following statements concerning **conflicts over irrigation**:

| | Statement | 1 Strongly disagree | 2 Disagree somewhat | 3 Not sure | 4 Agree somewhat | 5 Strongly agree |
|-----|---|---------------------|---------------------|------------|------------------|------------------|
| C37 | Conflicts over irrigation are very common | | | | | |
| C38 | Conflicts are usually solved | | | | | |
| C39 | Conflicts are usually solved fair | | | | | |
| C40 | Conflicts increase during water scarcity | | | | | |

C41 How long does it usually take to solve a conflict? _____

VII. NESTEDNESS OF INSTITUTIONS/RELATIONSHIP AMONG WATER USERS

How would you rank your **relationship** with other water users in terms of access to and use of water resources for irrigation?

| | Water user | 1 Very bad | 2 Bad | 3 Fair | 4 Good | 5 Very good |
|-----|---------------|------------|-------|--------|--------|-------------|
| C42 | TANESCO | | | | | |
| C43 | National Park | | | | | |

If 'bad', why?

C44 Do rules of management differ from canal to canal?

| Difference | No | Little | big |
|--------------------------------|----|--------|-----|
| Rules governing irrigation | | | |
| Productivity (agric.) | | | |
| Water distribution along canal | | | |

FUTURE

D1 What do you think are the main future challenges within your village concerning water access and distribution?



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