Future Agricultures

MZUMBE UNIVERSITY
(CHUO KIKUU MZUMBE)

University of Sussex
Global Studies

Working Paper

The Politics of Small-Scale Irrigation in Tanzania: Making Sense of Failed Expectations

Anna Mdee with Elizabeth Harrison, Chris Mdee, Erast Mdee and Elias Bahati

September 2014

About the Authors

Anna Mdee is a Visiting Professor with Mzumbe University, Tanzania and a Senior Lecturer with the University of Bradford in the UK. She directed this case study and oversaw fieldwork in Tanzania

Elizabeth Harrison is Reader in Anthropology at the University of Sussex. She is Principal Investigator for the DFID/ESRC Growth Research Programme project on which this working paper is based: 'Innovations to promote growth among small-scale irrigators: an ethnographic and knowledge-exchange approach' (ES/J009414/1).

Chris Mdee was Fieldwork Co-ordinator for this study. He is undertaking an MSc in Economics and Finance for Development with the University of Bradford.

Elias Bahati was a Fieldwork Assistant. He is undertaking an MSc in Development Policy with Mzumbe University.

Erast Mdee was a Fieldwork Assistant. He has a BSc in Local Government Management from Mzumbe University.

Table of Contents

Table of Figures

List of Tables

Summary

This working paper examines the dynamics of small-scale irrigation in two sites in Tanzania. It is an output from a wider project which explores how institutions for small-scale irrigation combine localised moral economies with national and international influences.[1] The project seeks to understand how 'external' actors interact with 'local' norms, rules, moralities and politics, particularly in the context of climate change. It further asks how economic growth objectives can be reconciled with strengthened livelihoods and the resilience of diverse stakeholders.

The data collection for the Tanzanian country study was co-ordinated by Prof Anna Mdee of Mzumbe University. Research took place between June 2013 and January 2014 and included a questionnaire survey, farmer interviews, focus group discussions, documentary analysis and participant observation.

The two study locations illuminate different aspects of the policy context for irrigation in Tanzania, where agriculture continues to provide employment for more than 80 percent of the population, but productivity remains poor and livelihoods are highly vulnerable. The latest policy initiatives aimed at developing agriculture such as Kilimo Kwanza suggest a significant role for irrigation in improving the productivity of agriculture, and will be crucial in attempts at commercialisation and growth. Tanzanian irrigation policy shows a clear preference for the creation of large irrigation schemes to be managed by the private sector or by co-operatives of small farmers. 'Traditional' irrigation is only seen as desirable where it is 'improved' and formalised to fit within existing institutions of water management.

To explore this policy context further, the study covers one location where irrigation is informal and 'traditional' but apparently improved by a change in technology, and one large irrigation scheme managed by a co-operative of small-scale farmers.

- **Informal and 'traditional' hillside irrigation:** Farmers in Choma in the Uluguru Mountains practice irrigated vegetable and fruit production using hosepipes and sprinklers. From small plots on the steep mountainsides they can produce sufficient quantities of crops for commercial sale. This production is a significant contributor to the sustainability of their livelihoods. However, their water use is informal and is considered 'illegal'. Attempts have been made to evict the farmers from the mountain, as one narrative suggests that they are reducing and contaminating the water supply for Morogoro Municipality. The study reveals competing narratives for water use and the limitations of formal bureaucratic institutions of water management to accommodate informal and traditional water use.
- **Formal and bureaucratic:** The 2,000ha Dakawa Rice Farm began life as a state farm constructed with donor support in the 1980s. Its most recent reinvention is as an irrigation scheme managed by a co-operative society of small-scale farmers. Nearly 1,000 members farm irrigated blocks of paddy. With recent inputs of aid under the United States Agency for International Development (USAID) Feed the Future Programme, and earlier inputs from the Japan International Cooperation Agency (JICA) under the Project for Supporting Rice Industry Development in Tanzania (TANRICE), there is evidence that the productivity of farmers has doubled and even tripled in some cases. However, this productivity increase is offset by a significant fall in the selling price and significant problems with marketing and transport. The sustainability of the scheme is further threatened by the falling levels and (effectively) unregulated use of the Wami River, the high cost of electricity to run the water pumping station and a dependency on aid inflows for organisational viability. Some also cast doubt as to whether the scheme benefits small farmers or whether it is effectively a cover for large landowners to benefit from subsidised rice production.

Whilst our study locations deal with irrigation at different scales and with entirely different structures of management and technology, they do both point to some common conclusions.

Firstly, there is a chronic weakness in the current formal institutions of water management. The local River Basin Board which issues permits for water use does not have the capacity to regulate the amount of water that is being used. This lack of monitoring and regulation leads in Choma to a narrative of blaming the small 'illegal' water user for taking more than their fair share, and in Dakawa it threatens the long term viability through the falling levels of the river.

Dakawa Rice Farm – the epitome of the ideal of Tanzanian irrigation and agricultural policy – is highly politicised in terms of management and access to land. Without aid inputs the scheme would once again be in danger of bankruptcy. The ideal looks vulnerable.

Fundamentally, without mechanisms to adjudicate competing uses of water, irrigated agriculture cannot be a solution to driving the commercialisation and growth of agriculture in Tanzania. With the impending (but uncertain) impacts of climate change, high rates of growth in other areas of the economy, and persistent population growth, competing uses for existing water sources will grow ever stronger.

1. Small-scale irrigation: Making sense of failed expectations

Small-scale irrigation is often seen as an important part of the mix to improve both economic growth and resilience to poverty in sub-Saharan Africa. This is particularly the case in the context of climate change, including both drought and the increased unpredictability of weather patterns. However, despite its apparent promise and potential, it appears that small-scale irrigation is neither widespread nor successful in SSA. The explanations for this combine the technical, the economic and the social, and within the latter the relationship between diverse institutions is centrally important. How do external actors interact with local norms, rules, moralities and politics? How do these processes change with both climate change and changing economic forces? A research project supported by the UK Department for International Development (DFID) and Economic and Social Research Council (ESRC) Growth Research Programme (DEGRP), *Innovations to promote growth among small-scale irrigators: an ethnographic and knowledge exchange approach,* is seeking to find answers to these questions. The three-country study involves research in Tanzania, Malawi and Bangladesh. This working paper is an output of the wider project.

In recent years there has been increased interest in support for irrigation, and in particular for small-scale farmers, from development organisations such as the World Bank, UN Food and Agriculture Organization (FAO) and United States Agency for International Development (USAID). For example, the World Bank doubled its lending for irrigation between the periods 2000–2005 and 2006–2010 (You et al. 2011). The policy of 'irrigation management transfer' (IMT) has been significant in this context. This became particularly popular during the 1990s. IMT seeks mechanisms for transferring the management of irrigation systems from governments and donors to 'communities', based on the combined ideas of participation, local control and a reduction of the role of the state. An FAO synthesis report on IMT (Garces-Restrepo et al. 2007) presents a comprehensive review of global progress on this, which is found to be mixed. Social and political factors are identified as key constraints. These include an apparent lack of capacity among the water users associations (WUAs) that are expected to take over irrigation management.

This last point is important: most donor and government-supported irrigation is based on the assumption that formal management organisations are essential. Understanding how institutions operate and relate to one another is therefore a critical part of the picture. In the context of sub-Saharan Africa, formal management always intersects with apparently less formal and 'traditional' practices and institutions. There is a substantial literature which documents such traditional systems, many of which are rooted in a pre-colonial past. These are described in extensive detail for Kenya (Adams et al. 1997) and Tanzania (Hillbom 2012; Tagseth 2008; Gray 1963). The gravity-fed irrigation practices in the area around Mount Kilimanjaro in particular are seen as especially well-developed examples of indigenous irrigation, and longstanding irrigation practices also exist in a range of other countries, including Ethiopia, Uganda and Zimbabwe (see Hillbom 2012). For some commentators, these constitute a source of hope and inspiration, reflecting ways of managing resources that are 'anchored in the wisdom of time' (van Koppen et al. 2007: 2). For others, especially some state representatives, they are more of a barrier or cultural impediment, especially when they come into conflict with modern, formal ways of organising the management of natural resources.

This project takes a perspective which seeks to move beyond such a clear binary. We suggest that the well-used dichotomies of 'traditional' versus 'modern' and 'informal' versus 'formal' practices may obscure considerable complexities and power dynamics, and it is these which we aim to uncover. Such binaries also assume an evolution from less to more market-oriented practices, which may not reflect the ways in which individual agency in practice intersects with structural location. We work with a more fluid conception of the institutions and rules that govern small-scale irrigation. In this, the theory of 'institutional bricolage' is useful (see for example Cleaver 2012; Komakech et al. 2012; Merrey and Cook 2012). The concept of 'intellectual bricolage', Cleaver explains, was first developed by Claude Levi-Strauss to refer to the ways in which people in 'primitive' societies creatively draw on diverse sets of ideas in their approach to making sense of the world, but within certain structural constraints. The bricoleur is a kind of 'amateur handyman rather than an engineer or craftsman' (Cleaver 2012: 34), making do with whatever tools are at hand. Building on this, the concept of bricolage as applied to resource management institutions posits a kind of institutional 'do-it-yourself' rather than more explicitly rational forms of institution-building as implied by, for example, New Institutional Economists such as North (1990) and Ostrom (2005; 1990). It has the advantage that it transcends the dichotomies of formal/informal and modern/traditional, focusing on questions of how different institutional arrangements gain both legitimacy and authority. This involves considerable contestation – in which claims to modernity and tradition are themselves an important part of the process.

In such processes of institutional bricolage, new institutions and rules may be formed, and these are partly a reflection of people's existing identity and interests; notions of 'community' thus need to be interrogated, both because 'communities' are internally differentiated (gender, migration status, ethnicity, age and many other identity factors may all influence this), and also because the boundaries of what constitutes a community are at the very least contested. When it comes to community in the case of small-scale irrigation, this is doubly important; as Komakech et al. (2012) have shown, the 'hydraulic position' of different users of a water resource (upstream or downstream) is one important driver of institutional

innovation. Beyond this, diverse other characteristics may play a role in shaping the power that people are – or are not – able to exercise.

Importantly, therefore, we argue that it is necessary to understand how rules and institutions evolve in ways that reflect power across levels. This means considering the ways in which national and international politics and history intersect with various dimensions of the local. In this, broader ideas of the nature of rights, citizenship and property may be particularly significant. As Lockwood notes,

> ... while the role of institutions in building adaptive capacity is increasingly recognised, especially at the community level ... there appears to be relatively little research on the exact nature of institutional problems and their relationship to politics at the national level. (Lockwood 2013: 654)

The state in its various forms, national and international donors and local institutions all need to be understood as they relate to one another.

This perspective has informed the research project so that, in documenting the rules and norms that shape irrigation practice, we also seek to understand how these intersect with ability to shape such rules. In addition, we explore in concrete terms the implications of all of this for livelihoods, resilience and sustainability.

2. Methodology

2.1 Research approach

The overarching approach to fieldwork in the three-country research project is based on the theoretical approach outlined above and designed by the principal investigators at the University of Sussex, UK, Drs Canford Chiroro and Elizabeth Harrison. This approach combines ethnography with quantitative data collection. For each of the countries the research strategy incorporated analysis of policy issues and interviews with key informants from a range of organisations (local to national levels); questionnaires in study locations to capture issues of local context; collection of secondary sources; and ethnographic research incorporating participant observation, focus group discussions, key informant walks and institutional analysis. Prof. Anna Mdee of Mzumbe University was appointed to undertake the Tanzanian country study, and she worked in collaboration with three Research Assistants in two locations.

2.2 Ethnographic study site selection

Mzumbe University is located in Morogoro Region and therefore the requirements of ethnographic engagement favoured the selection of study locations that could be visited several times in the course of data collection. An initial scan of existing academic literature and of the Tanzanian policy environment suggested that exploring two contexts of small-scale irrigation would be beneficial: informal and 'traditional' as we find in Choma in the Uluguru Mountains; and formal and bureaucratic as we find in the Dakawa Rice Farm. These cases have proved to be a fascinating contrast, but at the same time demonstrate fundamental common weaknesses in relation to water management in Tanzania.

2.3 Data collection

Guided by the overarching framework the initial phase of the study was a series of key informant interviews and a farmer questionnaire in both locations. During June and July 2013, 102 questionnaires were collected in Choma and 115 in Dakawa. Research assistants selected participants randomly and they were interviewed in their homes or at work in the fields. Secondary data and policy materials were collected from relevant stakeholders and online sources and provided the materials for the policy context in the next section, as well as detail on the individual study locations.

Key informant interviews were also conducted within relevant local government departments, local universities, non-governmental organisations (NGOs) and other development partners. Some key informants were interviewed on several occasions between June 2013 and January 2014. In this document such interviewees have all been anonymised.

A number of farmers included in the questionnaire samples were visited on several occasions in this period. Repeat interviews (in groups or individual) were conducted, as were farmer walks. Again quotations and data are anonymised. In Dakawa, additional financial interviews were also conducted with a purposively selected group of farmers.

All research documents were translated into KiSwahili by the Mzumbe University team. All research interactions (with the exception of some of the development partner interviews) were also conducted in KiSwahili. Transcripts of interviews were translated, scanned and saved to a shared folder.

2.4 Data analysis

Questionnaire data was compiled from individual questionnaires and presented using a simple excel worksheet, given that the data was only required for simple descriptive statistics and context setting for the later ethnographic fieldwork. Ethnographic data was thematically analysed according to the agreed framework.

3 Policy context

3.1 *Irrigation and agricultural policy in Tanzania*

Despite the emergence and development of industries such as mining, tourism and services in Tanzania's economic growth, agriculture continues to be a significant component due to the number of poor it employs and also the strong consumption linkages it has with other sectors (Coulson 2012; Jenkins 2012; Aman 2005). The exact proportion contributed by agriculture to Tanzanian gross domestic product (GDP) is not universally agreed but estimates range from 25 percent (UNDP/URT 2012) to around 45 percent (Keraita et al. 2010) of the total GDP, and from 30 percent (Keraita et al. 2010) to 85 percent (UNDP/URT 2012) of export earnings. However, what most sources agree on is that agriculture continues to provide a significant proportion of the livelihoods of 80 percent of the population (Coulson 2013; 2012; UNDP/URT 2012; Keraita et al. 2010). Therefore, supporting agricultural development not only offers pathways for the nation's economic prosperity, but also contributes to poverty reduction efforts (URT 2005).

(IFPRI It is suggested that for the agricultural sector to have a significant impact on a country's economic growth, and to actively assist in reducing poverty, its growth rate has to be at least 11 percent annually (IFPRI 2000). Agricultural growth in Tanzania has been significantly below this figure. Aman (2005) points out that Tanzania set a lower target agricultural growth rate of five percent by 2003, which was achieved in 2001 with rate of 5.5 percent followed by a slight dip to five percent in 2002. Figure 1 below shows agriculture and GDP growth rate up to 2007.

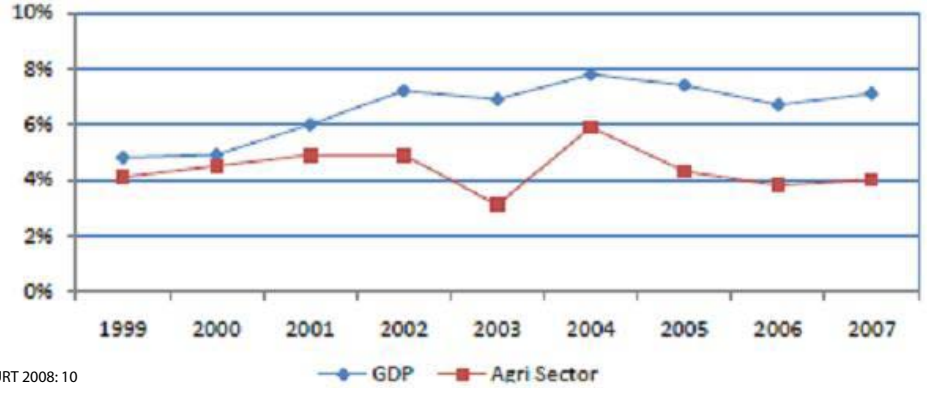
The Tanzanian Ministry of Agriculture, Food Security and Co-operatives (MoAFSC) actually suggests that the average growth rate for agriculture for the period of 1998-2007 has been an average of 4.4 percent. Figure 1 below shows that, apart from higher rates recorded in 2001 and 2002, we can clearly see a consistent low annual growth rate of about four percent throughout, which suggests a lack of progress in the sector.

Analysts such as Keraita et al. (2010), Aman (2005) and Jenkins (2012) have pointed to a varied range of constraints that prohibit the optimal level of production in the agricultural sector. Among these are the poor transport infrastructure, a lack of appropriate institutional frameworks, unfavourable market conditions, poor technology adoption and restrictive taxation and tariff regimes, together with the continued over-reliance on rain-fed agriculture. Aman (2005) stresses that despite there being abundant water in rivers and lakes, there is no significant utilisation of irrigated agriculture, and this is acting as a major hindrance to sustainable increases in crop production. Official estimates according to Keraita et al. (2010) reveal that only 300,000ha out of a potential 5.1m ha cultivated annually are under irrigation. The 2009 National Irrigation Policy also confirms this figure and recognises an increase in irrigated agriculture as a key component of enhanced agricultural productivity and growth (URT 2009a).

The latest country overview for Tanzania for 2014 characterises agricultural development as still weak, both in terms of providing opportunities for significant poverty reduction and for commercialisation (World Bank 2014). Current government initiatives such as *Kilimo Kwanza* (Agriculture First) and the Southern Agricultural Growth Corridor (SAGCOT) attempt to address these dual contributions: enhancement of the livelihoods of the poor and commercial opportunities for production (Coulson 2012; Jenkins 2012). Cooksey (2013) notes, however, that the policy environment around agriculture in Tanzania is increasingly contested and unclear. How the interests of the commercial investor and the small farmer can be served concurrently is also unclear. With the re-awakening of donor interest in agriculture, Tanzanian ownership of agriculture policy is weakened and reduced to chasing a plethora of competing and incompatible policies and projects. Cooksey notes that the poor farmer is unlikely to see significant tangible benefits from the current political economy of agricultural support.

Irrigated agriculture is seen as one way for small farmers to increase their productivity and improve their livelihoods. The critical challenge remains how irrigation can be efficiently and sustainably managed. Mutabazi et al. (2013) in their research in Central Tanzania note the significance of being able to invest in increasing

Figure 1: Annual Growth in GDP and Agricultural Sector 1998–2007



Source: URT 2008: 10

the productivity of irrigated land for small farmers to commercialise. However, there is little clarity as to where these mechanisms will come from.

3.2 *Institutional arrangements for irrigation among small-scale farmers*

The Tanzanian Irrigation Policy emphasises the use of formal irrigation 'schemes' as the primary mechanism for the scaling up of irrigated agriculture (URT 2009a). However, the issue of sustainability of existing and future irrigation schemes continues to cause problems in most of the initiatives that the government (through the Agricultural Sector Development Plan) has attempted to create. The reason for such a problem can partly be explained by the continued efforts by the government to push for rehabilitation and construction of the new schemes, whilst paying little or no attention to their day-to-day operation and maintenance, which are critical for their long term survival (URT 2009a; Abernethy 1994). Such shortcomings and failings are not unique to Tanzania but are found as a challenge in irrigation worldwide (Wiggins 2013; Mwakalila and Noe 2004). 'Traditional'[2] irrigation practices are characterised as inefficient and undesirable in the 2009 Irrigation Policy. The policy therefore aims to formalise and 'improve' such practices.

The capacity of irrigation management arrangements to fairly, effectively and sustainably manage water resources is much debated in the literature on irrigation in Tanzania (Rajabu and Mahoo 2008; Igbadun et al. 2006;

Table 1: Comparison of Cases

	CHOMA	DAKAWA
Location: key features	Settlement in a hillside location on the slopes of the Uluguru Mountains, above Morogoro.	40km from Morogoro, on the plain. Dakawa is both a settlement and a rice farm drawing people from this settlement and further afield.
The 'local people'	WaLuguru ethnic group, long established residents of the areas. In theory matrilineal. Some newcomers purchasing land on the lower slopes.	Mixed ethnicities, relatively recently settlement. Conflict between pastoralists and others.
Land access	Primarily customary tenure with limited land sales emerging.	Access determined through membership in irrigation scheme – either leasehold or freehold.
Irrigation practices	Hosepipes and sprinklers to grow vegetables and fruit; water from streams that feed the Wami River.	Furrow irrigation to grow rice, with water pumped from the Wami River.
Key institutions	No formal management of irrigation. NGOs promoting sustainable agriculture. Limited government extension presence. Morogoro Urban Water Supply Association (MORUWASA) concerned with effects of the irrigation. Wami-Ruvu River Basin Authority (WRRBO) as access regulator.	UWAWAKUDA Water Users' Association. Major external donors, including USAID, Japan International Cooperation Agency (JICA), China and Korea in the past. Government-supported extension and research centre at the farm. Wami-Ruvu River Basin Authority (WRRBO) as access regulator.
The important issues	Are farmers damaging the urban water supply? Are their practices sustainable? What are the politics of being 'organised' (or not) in addressing narratives of destruction?	The project looks successful in productivity terms but are there constraints to sustainability? What are the equity and political issues around access to land for irrigation?

Mdemu et al. 2004; Maganga 2003; ESRF 1997). These sources argue that institutional management of irrigation in Tanzania usually lacks the capacity to optimise water use. Further, and significantly, there is insufficient research in Tanzania on the economics of competing uses of water. For example Kadigi et al. (2008) compare water use for hydropower with water use for irrigation. Their conclusion is that water for agriculture has greater pro-poor benefits, but water for energy has greater macro-economic impacts. There is an urgent need to address these trade-offs but the Tanzanian institutional landscape is chronically lacking in the capacity to do so.

Therefore, in considering how irrigated agriculture can play a part in improving small-scale agricultural livelihoods we need to be aware of the Tanzanian policy context that favours private and donor-funded investment in large schemes, and seeks to formalise traditional irrigation practice. The academic literature points to significant gaps in institutional capacity to manage existing irrigation projects fairly and efficiently.

As a means of exploring this further, we take two contrasting ethnographic studies to reveal the interplay of institutions, power and politics in managing irrigation. The first case, of Choma in the Uluguru Mountains, considers informal irrigation for vegetable and fruit production by the long-time local inhabitants. The informal water use in this case is classed as 'illegal' by the Tanzanian Water Management Act. The second case considers Dakawa Rice Farm, which in itself represents a history of irrigation management in independent Tanzania. The former state rice farm is now run by a co-operative society of small farmers and with donor inputs. It is considered to be an ideal case for how to improve small-farmer productivity and livelihoods. Table 1 summarises the cases, which are then explored in further detail.

4 Informal and 'traditional' irrigation: Contested narratives of sustainability

4.1 Introduction: Location and context

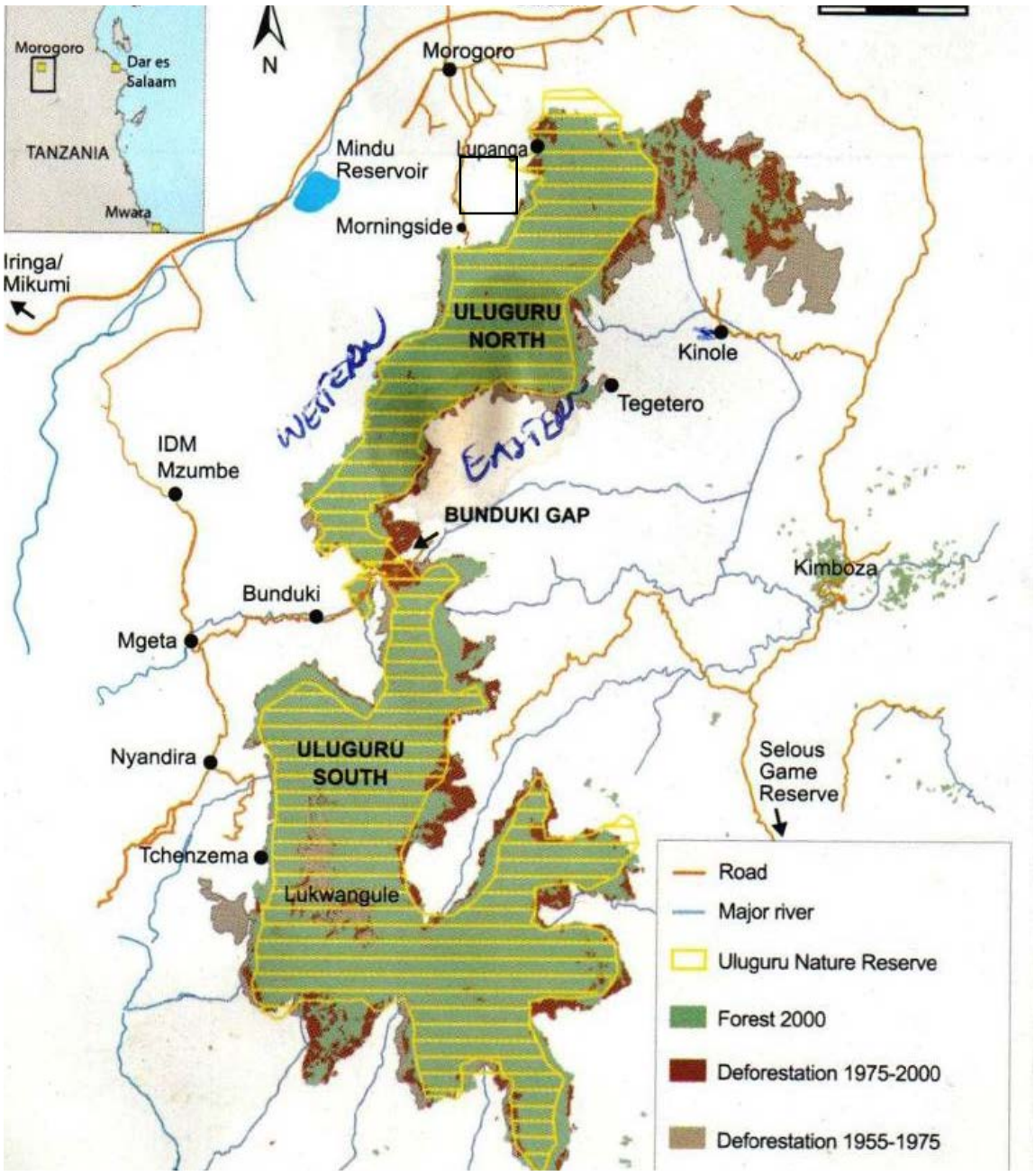
The settlement of Choma is situated in the Uluguru Mountains above the city of Morogoro. It lies in one of the catchment zones for the Morogoro Municipality domestic water supply. The Uluguru Mountains themselves are a significant catchment area for the city of Dar es Salaam and the Dar es Salaam, Morogoro and Tanga regions. In Choma farmers have developed innovations in irrigation which are important for their livelihoods. However, these practices have contributed to an ongoing debate concerning the future of settlement in the mountains.

Choma is in the local government ward known as Mlimani, which includes the settlements of Choma, Mbete, Paku and Mlali. These are no longer official villages but are part of the Morogoro Municipality. They are areas referred to as streets (mitaa). The settlements are on the slopes below the Uluguru Nature Reserve. Figure 3 shows the location of the villages, marked on the map with a square.

The terrain is steep and visiting involves a two-hour walk from the last motorable point. Villagers have recently organised to extend the road, however, so that motorcycles will be able to carry people and produce more easily. Given the steep terrain, the climatic conditions on the mountain can be highly variable. Meteorological data is not available for Choma itself, but data available for Morogoro indicates increases

Figure 2: General terrain of study area

Figure 3: Map of Uluguru Forest Reserve.



(Source: UNR leaflet)

Indicates location of study area.

in average temperature over the period since 1977. Data for Morogoro also suggests a reduction in annual rainfall of around 100mm in the 30-year period covered by the data. In contrast, there is also data to suggest that the mountainside has considerably more rainfall than Morogoro Town – more than double in the period up to 2007 (URT 2009c). It is this rainfall which feeds small streams and rivers on the slopes of the Ulugurus that are used for irrigation by farmers in the area. The significance of these differences between Morogoro Town and the mountainside is that although there is a perception that rainfall is decreasing, in fact in the main catchment for Morogoro Town rainfall is increasing rather than decreasing. This might suggest that decreases in water availability downstream are related to increased population and usage upstream, as well as inefficient storage of water downstream.

There is no accurate population data available for the area known as Choma but local estimates suggest the population of Choma is around 600 households. Our survey shows an average of four people per household (two adults and two children). It is striking that 97 percent of those in our survey reported that they had always

lived in their current location. This is confirmed by further interviews and literature (URT 2007) which reports that the Uluguru population are predominantly from the WaLuguru ethnic group and Muslim.

Academic literature and some key informants indicate that within the Ulugurus there is a strong and uniform pattern of matrilineal inheritance, with the movement of men to the wife's household on marriage. However, we found the actual practices and patterning of inheritance to be more complicated than this. Whilst some farmers said land was inherited from their mothers, most said they inherited from their parents without differentiating gender. Some women said they were given land by their husbands, who had themselves inherited it from their parents.

The vast majority of land in Tanzania falls under the 1999 Villages Land Act where allocation of land is managed and regulated by the Village Government. Individual land titles are issued under this system and recorded by the village. Land is under leasehold and must be used productively or can be reclaimed for reallocation by the Village Government. In the case of Choma, a more customary freehold system regulated by the WaLuguru claims remains dominant. Our survey also indicates that farmers control an average of 1ha each, comprising 0.56ha of dry land and 0.44ha of irrigated land. 97 percent of this land is held as customary freehold and inherited, although interviewees stated that the informal purchase of small plots is becoming common. There is very little officially titled freehold land in the Ulugurus. However, urban development is increasing rapidly on the lower slopes, much of it unregistered and illegal.

People living in the Choma area are predominantly crop farmers, supplemented by business activities and livestock keeping. Only three percent of those in our survey had formal employment. Education levels are similar to those in the country as a whole, where in the latest Human Development Report the adult population had a mean of 5.3 years of schooling (UNDP/URT 2012). In Choma, 93 percent of those surveyed had primary schooling only, four percent had secondary education and three percent had no education.

Formal institutions have a limited presence in the Choma area. Representing local government, Morogoro Urban Water and Sewage Authority (MORUWASA) is working on water catchment tanks and improved inflows on the slopes below Choma using the same river as is used by the Choma farmers. The Wami-Ruvu River Basin Office has responsibility for the water management as a whole, and for the formal registration of Water Users Associations (WUAs), but at the current time there is no formally registered WUA in Choma.

A range of NGOs provide agricultural extension services and support to farmer groups. The Uluguru Nature Reverse (UNR) which borders this area is managed by the Ministry of Natural Resources and Tourism. UNR has received various inputs to environmental management projects in recent years, for example a Payment for Watershed Services Project funded by CARE and the World Wide Fund for Nature (WWF). This covered villages on the eastern side of the Ulugurus. The Wildlife Conservation Society of Tanzania (WCST), a partner of Birdlife International, has also been active in the Ulugurus. WCST has received funding from the Civil Society Challenge Fund of DFID to operate another pilot Payment for Watershed Services Project. This covers the western side of the mountain and includes the Choma area.

The NGO Sustainable Agriculture Tanzania (SAT) is supporting an organic farming group who are working towards collective organic certification for their produce, as has been achieved by other SAT groups in the area. They have a demonstration farm in the Choma area. Inputs are low cost and often demonstrate the use of accessible and available local plants to make pesticides or fertilisers (for example the use of chillies as pesticide and leaves of *mishomoro,* a common hedging plant, as fertiliser).

Lastly, some enterprising young men have formed KIMIMICHO, a local environmental group. This aims to develop both sustainable farming and some ecotourism in the area. They earn income by acting as guides for tourists who want to walk in the hills or swim in the waterfalls.

4.2 Irrigation and livelihoods

Irrigation in the Ulugurus has a long history. From the nineteenth century, were it was possible given considerations of topography, most irrigation was practiced through a furrow system. This was banned around 2004 in the Choma area by local government. Subsequently, farmers moved to using gravity-fed hosepipes which tapped into the rivers and streams.

Irrigation as currently practiced is determined by access to land and capital to purchase hosepipes and sprinklers. Hosepipes have extended the area of land that can be irrigated but there are still technical and topographical limitations. Figure 4 shows irrigated strawberry production.

Figure 4: Strawberry production based on hosepipe irrigation

According to farmers, the reason that local government restricted the use of the old furrow irrigation system was that it was very wasteful in terms of water use. The farmers themselves found the use of hosepipes not only increases efficiency of water use but also decreases their labour requirements in digging and maintaining furrows.

> Before starting pipeline irrigation, with the furrows we would lose most of the water before it got to the farm. They also used a lot of energy to construct them. Using the furrows was the hardest life and this led people to learn a different thing. (Male farmer, August 2013)

> Long ago we were using furrows but the government officials came to destroy them saying that they were using too much water. They haven't tried this since we started using hosepipes. (Male farmer, August 2013)

Irrigated fields lie alongside the steep river valleys, and on terraced slopes farmers report that at certain times of the year the levels of the streams decline, depending on the extent of the short rains.

> Sometimes there are small disputes rising, especially in December to February because in these months the levels of the river are dropping, then the one who is up is getting a lot compared to the one who is down and the one who is up may refuse to cut off their pipeline. Then we take the dispute to our street (village) chairperson. (Female farmer, September 2013)

There are no formal institutional bureaucratic arrangements for water sharing but there is evidence of informal institutions that are deeply embedded in the socio-cultural life of the people of Choma. Individuals purchase hosepipes but might be using them in co-operative arrangements with their friends and family, many of whom have lived in the same location for generations.

> The one who is responsible for the pipeline is the person themself. It is their own property. Sharing is important because today you may help somebody and tomorrow you may be helped because nobody knows tomorrow. It is true that some would like to access water but they fail because they don't have money to buy the pipeline. (Female farmer, September 2013)

Irrigation practice is embedded in longstanding social relationships. People do not articulate these as rules but as their way of being 'together'. At the same time, water access is constrained by land ownership (through inheritance or through purchase) and technological limitations. New technology has been adopted into these relationships but local government intervention has been actively resisted. Most interviewees emphasise fairness and sharing in relation to water use that draws on their social connections.

> The fairness in sharing water is very important since every farmer needs water for irrigation, so unfairness is like selfishness. (Male farmer, August 2013)

> I believe in these people that I am sharing the water with since most of them are my relatives and in our tribe we have the system of helping one another. (Male farmer, August 2013)

> For me, because I share with my relatives we don't fight over water that much, but I have seen people falling out over whose turn it is to use the pipe. This is not very common as most people try to buy their own pipes. (Female farmer, September 2013)

There is no formal system for determining water availability. Within the cooperative arrangements of neighbours, if it is perceived that water levels to the hosepipes have dropped then they will discuss and agree amongst themselves on a rota to share the water that is available. If water levels drop very low then they may irrigate at night to improve efficiency.

Irrigation is centrally important to farmers' livelihoods. Without it they would be dependent on rain-fed agriculture and probably could not sustain themselves in their current location. In our farmer survey, 97 percent of farmers were irrigating and 97 percent of those were using the small streams and rivers flowing down the mountainside. One percent reported using a borehole and two percent natural wetlands. On the irrigated land there is a high diversity of vegetable crops including carrots, celery, onions, lettuce, Chinese cabbages, cabbages, leeks and coriander. Fruit crops include tomatoes, peppers, passion fruit, papaya, bananas, strawberries, raspberries and other berries. The crops have a good market in Morogoro. Farmers often sell directly to expatriates and wealthier local families and fruit is also sold at the door of the supermarkets in Morogoro.

Strawberry production is unusual in Tanzania and these have good markets in Dar es Salaam and Arusha. A small tub of strawberries can be sold on the street for 3,000Tsh (US$1.80) or to tourists for 5,000Tsh (US$3). At the farm gate, the farmer may receive 1,500Tsh (US$0.90) per bowl. Production is continuous all year round. Farmers keep no written records and estimates of gross income made from one acre of strawberries varied from 800,000 to 2m Tsh (about US$1,200-3,000 per hectare). In most cases farmers do not calculate their profits. However, farmers report that income from strawberries exceeds the costs of inputs and has enabled them to purchase items such as motorbikes and pay secondary school fees. Interviewees report that buyers for strawberries also come direct to their farms. On the dry land (often steep terraced slopes), farmers predominantly grow a mix of maize and beans once per year according to the rainy season.

Agricultural livelihoods are therefore clearly dependent on water, which is generally seen to be sufficient. There is seasonality to flows but the co-operative arrangements

between farmers enable them to cope with this. There is much more of an issue with water availability on the rain-fed land where farmers talk about their production as being more open to chance.

4.3 Narratives of sustainability and destruction in farming

Farming activities inevitably have an environmental impact and the nature and extent of this has been the subject of considerable discussion and contestation. This concerns both effects on the immediate environment and wider concerns about possible effects for those downstream due to the water use. In these debates, the narratives of sustainability associated with improved farming practices supported by NGOs can be contrasted with accounts of destruction from other institutions and actors.

There is certainly some evidence of practices that are considered to have negative effects. For example, observations confirm that some farmers burn vegetation to clear land, and many farm highly sloped plots without terracing and encroach on the forest reserves. To build terraces is labour-intensive and expensive and many slopes are therefore still farmed through burning and hand hoeing. In response to this, an NGO has encouraged farmers to construct terraces with cash payments. In contrast, farmers are also using a great number of environmentally sensitive techniques. In our survey, 85 percent reported using conservation tillage in the form of terraces, 53 percent use legume incorporation (particularly on rain-fed land), 62 percent practice crop rotation and 84 percent are incorporating manure or compost on to their land, while four percent are using infiltration pits. Our research suggests that farmers predominantly learn farming techniques from their parents and their neighbours.

> I learnt to grow the crops that I am producing through my parents and other people who surround me. I learnt from them about terracing and other techniques. There is not any one organisation that provides agricultural information but what I do is use my own experience. To me the best farmer is one who is irrigating as well as creating terraces, using local fertiliser (*samadi* – generic term for manure) and is doing organic farming. (Male farmer, October 2013)

It is interesting that this farmer does not identify NGO involvement in his learning but does mention organic farming. Others suggest that knowledge comes from local NGOs and this knowledge appears to be relevant and accessible to them.

> NGOs such as SAT and WCST come to talk to us on good farming practices. They provide important information on contours, organic farming – this is good information which we can use. I believe a good farmer is one who can farm organically and using conservation tillage on the mountainsides. They are the best as chemicals have negative impacts on the environment and can even poison the consumers. (Male farmer, August 2013)

There is also evidence of a high degree of openness to new techniques, particularly when they can see definite improvements to their productivity, for example with the use of contouring and terracing on the steep slopes in combination with organic cultivation techniques. There is little evidence of activity driven by local government extension officers, and some key informants suggest that, with very few exceptions, they are rarely present in the mountainous areas given the severe problems of transportation.

Figure 5: Terracing on steep slopes in Choma

Despite all of this evidence of adoption of new techniques, farmers in the mountains are often branded as incapable of learning by local government officials.

> The main barrier is knowledge exchange, especially when there has been seminar and training. There is a lack of co-operation, there is no willingness to comply with the new farming techniques that are aiming to conserve the water source since their prime intention is to use water for their farming and not for the people of Morogoro. Also the accessibility to the area is very restricted and those people have a lack of education so it is difficult to explain and to make them understand the benefits. (Local Government Livestock Officer, September 2013)

As described above, there are no formal structures for irrigation management in Choma. However, officials within local government argue that they are needed. This is part of a wider concern with the possible effects of this irrigation on downstream water supply, and possibly with the very fact of lack of regulation. Thus, according to interviews with Local Government Extension Workers, Ward Secretaries and staff of MORUWASA and WRRBO, irrigation in Choma is illegal as farmers have not been organised into WUAs and issued with water permits.

> At the moment there seems to be no formal arrangement to manage water access. However they are in the process of coming up with one. This will help to manage water usage, how much that can be used and formal rules that can be applied. (MORUWASA Officer, October 2013)

Another informant, from an NGO, argued that:

> The population is growing and even their kids are going into the same business. So with the climate change issues and the amount of rain, even with hosepipes then they can't take enough water to meet their family needs. The approach that Wami-Ruvu [WRRBO] is taking is to tell them to pay their bills. They are supposed to establish a water user's association but the people are resisting to pay. (WCST Officer, September 2013)

As described above, within itself the informal system of purchasing hosepipes appears to be working well, whilst water use is unregulated by external intervention. Farmers report high levels of cooperation and there is little evidence of water shortage or conflict amongst farmers. The challenge lies not with the internal arrangements for water sharing but rather in the more extensive question of upstream and downstream water use. Local government officials perceive that Choma farmers are in conflict with the urban supply to Morogoro, both in terms of quantity and quality of water. As one told us:

> People are living very close to the intake and they are diverting the water – they are taking more than 50 percent. In 1999 there were only about 500 people living there and then the government built schools, a hospital and brought electricity. This has encouraged people to come and build. (MORUWASA Official, October 2013)

Another informant said:

> They have created their own way of irrigation that the government does not approve of. The use of hosepipes is against the law and so they do this illegally. The rule is that they are not allowed to farm within 60 metres of the water sources, however none of the residents comply with this. (Local Government Ward Officer, August 2013)

However, other perspectives tell a different story, suggesting that the small-scale hosepipe irrigation is insignificant with regard to the Morogoro water supply. An alternative explanation is that the real problem is the larger scale construction of dwellings for wealthier residents on the mountains. For example, we were told that:

> There are many illegal constructions in the mountains and we need to preserve the water sources, but also even big institutions like the Universities and Army bases have not been regulated for their water use. We have not been able to do this as yet. (WRRBO Official, November 2013)

It was this argument over water usage on the mountain that led in 2006/07 to an attempt to evict farmers from Choma (and other areas) and to relocate them. In response, a group of residents went to the President to resist the move, and in 2009 they were told that they could stay – for now.

The current government position is that if they cannot force the farmers off the mountains, then they need to be taught to farm in an environmentally sustainable way. This work is seen to be the remit of NGOs, rather than of government agricultural extension officers. At a higher institutional level there appear to be several themes to discussions on the challenges of the informal irrigation arrangements in the Ulugurus, but as yet no implementation or concrete action plan has been proposed to formalise the irrigation. WRRBO ideally wants to formalise arrangements and make farmers pay for water, but does not currently have the staff capacity or financial resources to do so. Some suggest that ultimately the farmers will have to be moved. Reporting on a discussion from the task force established within the Morogoro Municipality Council to review the issue of water use on the mountain, we were told that:

> We talked about the options and we think that there around 10,000 households that would need to be moved from the mountain and the costs of compensation are just too high. They did a survey about this but it was disrupted by political things. (WCST Staff Member, September 2013)

There are also indications of the significance of the wider political nature of the scheme to move the farmers from the Ulugurus, which connects to a wider landscape of hydro-politics.

> The Mayor of Morogoro told me about the pressure that was put on him to move the people from the mountain. The problem is that the Ulugurus are vulnerable as they provide the water for Dar. The parliamentarians are getting pressure from the big industries such as Coca Cola and Tanzanian Breweries to increase the water supply, but they are also the ones who should be paying to conserve the environment in the catchments. (SUA Academic, October 2013)

The challenge with the informal nature of water use by the Choma farmers is that they have little visibility and representation as a group while they are informal. They have no official voice within the institutions that manage water. The farmers themselves appear to resist formalisation for fear that they will be made to pay for the water they use.

> There are no government policies about using water for irrigation and we don't want them because they will disturb us. We need freedom in irrigation. (Male farmer, October 2013)

4.4 Conclusions: Choma

This situation presents a paradox. If more formal mechanisms for water access were to be imposed through the formalisation of water access and creation of WUAs, this could have potentially negative implications for the vulnerability of the Choma farmers, as it would constrain their current water use. The impact of introducing a formal set of rules might also disrupt the relatively conflict-free informal water sharing arrangements. Conversely, however, formalisation could give the Choma farmers a more legitimate voice within the municipality in order to represent their interests.

The farmers themselves use their own production levels as the main indicator for the success and efficiency of their irrigation. There is no other formal monitoring of water levels or water use with regards to irrigation. Although local government officials speak of the desirability of monitoring water availability, they are not sure how to go about it. Similarly the key informant interviews with WRRBO suggests that ideally they should be measuring and regulating water use as against the permits issued, but the resources and capacity are lacking to do this. JICA/MoW (2013) confirms this observation in noting a concern that water rights are being sold, but no monitoring of water use is conducted.

This concern is further confirmed by an informal remark from a WRRBO employee:

> We just sell water, that is all we do.

5 Formal and commercialised irrigation: The case of Dakawa

5.1 Introduction

Dakawa is situated about 40km from the City of Morogoro on the road to Dodoma. It is in the Wami-Ruvu River Basin, close to the Wami River, and is the site of one of the largest irrigated rice schemes in Tanzania. Dakawa Rice Farm is a former state rice farm constructed with the assistance of North Korea during the 1980s but now managed by a WUA of small-scale rice farmers.

Dakawa Rice Farm appears to have been the site of repeated aid interventions and is currently the focus of USAID and Chinese projects. The farm has a chequered political history but is currently a 'pin-up' example of how irrigated rice can benefit small-scale farmers in terms of improving their productivity and increasing their incomes. As we will explore below, Dakawa highlights a number of themes that are significant for understanding the politics of small-scale irrigation.

First, there is an interesting underlying question as to the viability of irrigated rice production on the rice farm, given the high costs of pumping water from the Wami River and the low level of the river. In addition, the idea of 'smallness' is a contested theme in different people's understanding of how the scheme works and this in turn has important links with fairness, trust and transparency in the formal management of the scheme. Lastly, the high level of aid intervention suggests a complex politics of rice production and agricultural intervention in Dakawa, with implications for how donors support such initiatives.

5.2 Dakawa: The settlement and the scheme

The settlement of Dakawa is relatively new, with an agricultural population centred on the irrigated 2,000ha[3] rice farm. Our survey indicates that 77 percent had not lived in the area for all of their lives, with the most common period of settlement being in the 2000s. Interviewees confirm that the population fluctuates in relation to the labour demands of paddy production, and that many of the ethnic groups of Tanzania can be found there. There are significant numbers of Masaai pastoralists in the area and tensions over access to land and damage to crops are common.

Unfortunately, there is no reliable population data for Dakawa village, which is located next to the rice farm.

Survey results and observations in Dakawa indicate that livelihoods are predominantly agricultural with around half of our respondents relying on agriculture only. The other half combine agriculture with other activities such as small business (shops and bars) and livestock keeping. Only five percent of our respondents also have formal paid employment. The predominant crop grown is irrigated rice paddy, cultivated by 78 percent of survey households. On dry land, 47 percent of farmers produce maize and 16 percent rice, with small numbers also producing tomatoes, leafy vegetables and other crops.

Farmers in the Dakawa area tend to have a combination of land within the irrigated scheme and outside of it, which is used for rain-fed agriculture. Our survey found that average total land holding is 2.33ha, with 1.4ha of irrigated land and 0.9ha of dry land. Land within the rice farm is accessed by membership in the rice farm co-operative society, which we describe in further detail below. Dry land is roughly equally split between freehold and leasehold. In this case, freehold relates to titled or customary ownership overseen under the local government. Leasehold refers to the practice of renting land directly from a freeholder. As noted above, the area does not have a long history of settlement for agricultural production and therefore customary ownership is not significant. However, disputes over competing usage

between agriculturalists and pastoralists are common and have led to physical violence. For example, in November 2013 a dispute escalated into the slaughter of pastoralists' cattle, the burning of buildings in retaliation and the deaths of three people.

The Dakawa Rice Farm is operated by Ushirika wa Wakulima Wadogo Wadogo Dakawa (Society of Small Farmers in Dakawa), known by the acronym UWAWAKUDA. To access land within the scheme an individual must obtain membership of UWAWAKUDA. UWAWAKUDA is working with USAID on a project to rehabilitate the pumping station which draws water from the Wami River. The Chollima Research Centre (CRC), under the Ministry of Agriculture, Food and Cooperatives, is also located in Dakawa and uses 40ha of land within the scheme. It produces rice seed for the national Agricultural Seed Agency (ASA). Agricultural Officers from CRC work with local farmers on improving the productivity of rice production. CRC has a number of externally funded donor projects relating to rice productivity, such as an Australian-funded initiative on the System for Rice Intensification (SRI). The USAID NAFAKA project has also provided inputs to the rice farm, and there has been a move towards using the SARO5 hybrid rice variety and transplanting rather than broadcasting rice seed.

USAID are keen to promote the rehabilitation of Dakawa and in particular their work with the 'small' farmers, as is evidenced by well-publicised visits to the site (ACTI/VOCA 2013).

Dakawa is also the location for the Demonstration Centre of China Agricultural Technology in Tanzania. Opened in 2009, the Centre has 62ha of land and is experimenting with the production of Chinese hybrid varieties of rice, maize and vegetables as well as intensive poultry production. The Centre draws water from a borehole, not from the Wami River.

Outside of the Dakawa Rice Farm, land registration, allocation and agricultural extension work comes under the Mvomero District Council and the Dakawa Ward Office. The WRRBO oversees the use of water from the Wami River and can issue water rights.

5.3 Rice farming: Gains for farmers

Rice is the only crop produced within the scheme and a significant amount of work has been undertaken with scheme members on improving productivity, for example on systems of transplanting seedlings, and the use of manure and other inputs. Access to credit has also improved farmers' ability to purchase inputs. Several farmers report increases in productivity due to these inputs since 2011. Farmers report the potential to get up to 45 bags of rice per acre (approximately 124kg/ha) with current irrigation techniques. However, a number also report that in 2012 they were able to get 100,000Tsh (US$60) per bag of rice, but that in the 2013 season they received only 50,000Tsh (US$30). Therefore the increasing productivity has been offset by the decline in price. Interviews with farmers suggest that many farmers who had taken loans for their production costs were now concerned about their repayments given the drop in price they were able to get for the rice. There were also complaints that payment for rice came very late from the buyer. The market price received by the farmers is fixed by buyers who purchase rice in Dakawa. Rice prices in the market are quite volatile in relation to the production of local rice and importation (illegal and legal).

The farm currently has no storage facilities, processing capacity or transport. It was reported to us that the only milling machine was owned by the scheme under the JICA-supported Project for Supporting Rice Industry Development in Tanzania (TANRICE), but this was sold off to a private investor and the farmers told not to use it.

Some farmers suggest that rain-fed land could produce greater profits for rice production than irrigated land in a good year, as the land outside the scheme could be farmed with lower inputs and so have a lower production cost. Financial analysis of inputs and outputs, however, supports the different conclusion that in fact the irrigated land is more financially profitable for individual farmers (Mdee 2014). Many male farmers report that the scheme contributes to improvements in the family diet through improved ability to purchase other foodstuffs and income. However, other perspectives suggest a rather different story. As one female farmer said:

> The productivity has really done nothing to improve the family diet. My husband, soon after harvesting, is the one who is responsible for the money. Even when I ask how much money we have gained from the sale, he won't tell me, rather he will be abusive and insulting to me and my family. I am just here to cook, work and reproduce the kids. (Female farmer, September 2013)

This interview confirms what is already known from much literature on gendered aspects of food production: that it should not be assumed that increased production and income are shared within the household. In addition, regardless of where benefits lie at the household level, overall profitability calculations for individual farmers do not include the full cost of electricity and maintenance for the scheme as a whole, and so these profits are effectively subsidised. Analysis of the UWAWAKUDA accounts suggests that farmer membership contributions are not paying the full costs of production in the scheme and that large inputs of aid fill the shortfall (Mdee 2014).

5.4 Managing Dakawa: A turbulent history and a complex present

The current operating arrangements for Dakawa Rice Farm are the latest in a succession of attempts to manage it. Built in 1981 with aid from North Korea, it was originally a state rice farm under the National Agriculture

and Food Corporation (NAFCO) (Chachage and Mbunda 2009). NAFCO collapsed in 1996 and the farms under its control were sold or transferred to the Parastatal Sector Reform Commission (PSRC). Reportedly the farm was unused for a period of ten years before this. Following various different structures of control, and considerable contestation, UWAWAKUDA was established in 2003.

The first Chairman was deselected after two years because of dissatisfaction that some plots were inaccessible and did not receive water. The second Chairman, elected in 2005/06 for two years, was accused of giving plots to more than one person.

> At this point the Village Council decided that they wanted to take control of the farm and they installed their candidate to become the Chairman. (Male farmer, September 2013)

However, this new Chairman was also accused of malpractice:

> Another conflict emerged because water availability become more scarce and people who paid their money to get the plot didn't get any. There was a lot of conflict about money as it seems the money was not deposited in the bank. Therefore some people took the matter to the Ministry of Agriculture and they conducted an investigation. (Male farmer, September 2013)

Following an investigation, the previous Chairman was removed and the current leadership put in place around 2010. The current Chair is an employee of the Ministry of Agriculture and Food Security. He was appointed by the Ministry alongside a Deputy Chair, Bursar, Farm Manager and Pump Attendant, all installed for a period of three years to get the farm back on track.

> Since they took over there hasn't been a problem, money is available and the productivity has increased from 15-19 bags per acre to 30-35 bags. (Male farmer, September 2013)

This last period coincides with external intervention by USAID under its Feed the Future programme. Work on clearing irrigation channels and a feasibility study for the replacement of the existing pumps has been undertaken, alongside the provision of inputs discussed above. Nonetheless, as we develop below, there are continuing suggestions that the management of the scheme has been politicised, with positions of influence reflecting political party allegiances. In this account, the real small farmers of Dakawa are marginalised by less visible but more powerful political interests.

> If the Regional Commissioner wants his plots watered then all he needs to do is to call the office here and it will happen, even if it is not in the planned watering cycle. (Female farmer, November 2013)

Current membership of UWAWAKUDA is reported to be just under 1,000 farmers. However, this figure cannot be verified and it has been suggested that access to member lists is neither open nor transparent. Some went as far as to say that in reality many 'farmers' are simply labourers on other people's land.

According to UWAWAKUDA, the farm is divided into 12-acre blocks and the maximum area of land that can be farmed by one person is 12 acres (4.85ha). However, there is evidence of great variation in plot size. Some of

Figure 6: A 12-acre (4.85ha) rice block

Figure 7: Main irrigation canal

the blocks are farmed by more than one family as a result of lack of capital for investment (hence the average of 3.5 acres or 1.4ha per farmer in our survey). However, it is also reported that some families control several blocks by registering them under the names of different family members. Further, it has also been asserted that large blocks of land are owned by individuals working in government and the armed services.

All of the water for the Dakawa Rice Farm is taken by a pumping station from the Wami River, which flows through Dakawa. Each month, 15m Tsh (US$9,000) is paid by UWAWAKUDA to Tanzania Electric Supply Company (TANESCO) for electricity. Another USAID-funded project is underway to rehabilitate and install new pumps in the pumping station to make this operation more efficient.

However, there are problems because the flow of the Wami River restricts the operation of the scheme. In 2013 only one crop of rice had been cultivated as the level of the river was too low to run the pumps outside of the rainy season. This is attributed to competition from upstream users including large commercial investors who, it is said, are also taking water from the Wami.

> Water usage has increased due to irrigation. Long ago people did not know how to irrigate. We are trying to control this by giving permits and educating those who are water thieving. The river level has gone down due to the lack of rains and not due to the number of users. (WRRBO Local Officer, October 2013)

Water access from the river outside of the scheme is in theory regulated by the WRRBO. The local Wami-Ruvu River Basin Ward Officer explained that at the local level he is only responsible for registering new groups of Water Users and informing them of the regulations that are in place under the 2009 Water Users' Act. He is also responsible for enforcing this act but said that no one has yet been prosecuted under it.

All members of UWAWAKUDA are entitled to attend its General Meeting, where the Board Members, Chair and Secretary are selected by a vote. The Chair and Secretary are salaried positions. To access land in the scheme you must be a member, for which there is currently a waiting list. To become a member you need to purchase ten shares and these cost 10,000Tsh (US$6) each. The share does not generate a dividend.

The current Chairman of the Board is an Agronomist at the nearby Cholima Research Centre. The Board also employs a professional Farm Manager to supervise the pumping operations. Members of UWAWAKUDA pay 60,000Tsh per acre (US$90/ha) per year to cover the cost of electricity to operate the pumping station. Water is drawn from the Wami River by a pumping station and it is the Board who make decisions on when water will be pumped, and the cycle by which it reaches the different blocks. This charge does not cover the costs of electricity or the maintenance of irrigation channels. The management is responsible for the maintenance of the main canals and the pumping of the water. In theory these are covered by the fees paid by members, but accounts show a shortfall.

Within the 12-acre plots, the users are responsible for the maintenance of channels and water flows. Where multiple farmers share a block they elect a leader and must co-operate with one another on deciding when water is allowed in. Irrigation water is pumped according to a cycle agreed by the Farm Manager and the Board. Given the problems with the level of the Wami River, in the 2013 season water was pumped to the farms from April to July. The plots of land nearest to the pumping station are the first to receive water. Those plots farthest away from the pumping station do not receive water until several weeks after the first plots and therefore the timing of tasks and production varies according to the position of the plot within the scheme. It was reported that the timing of the flow can disadvantage those farmers with plots at the farthest corner, as by the time they receive the water the weather is already becoming colder (June/July). Farmers see this as unfair and note cases where some with the plots farthest away have failed to produce a crop.

Farmers need to decide collectively when they will open the gates to water the plots. They can make this decision when the water is flowing to their section of the farm. In principle anyone who is found to be stealing water can be expelled from UWAWAKUDA and there are

one or two examples of farmers being expelled as a result of conflict over water stealing during the night. Farmers uniformly say that fairness is important as a principle and on the whole agree that the formal system tries to be fair. Most farmers report that the current arrangements are working well. Given the turbulent political history of the farm, it was said by a number of interviewees that in the past pressure might be brought to bear on the farm managers to divert water to plots belonging to powerful individuals.

The main reported limitation arises where a number of farmers share a 12-acre plot and are at different stages of cultivation or using different methods of rice production (broadcasting versus transplanting), and so they may require water at different stages. Farmers within the blocks therefore need a high degree of cooperation, and this is not always present. There are cases of effective co-operation, for example:

> We have worked with each other for some time and so we know how to co-operate! (Female farmer, August 2013)

However, most farmers also say that this arrangement is the reason for conflicts and disagreements:

> We don't trust each other because everyone is looking after their own interest. Although we might be talking and sometimes do things like ploughing and harvesting together, deep down no one trusts anyone. (Female farmer, September 2013)

Another interviewee says that water theft is common:

> There is also water thieving, which is very problematic. It gives me as a leader of a block a moral dilemma as to whether to report them, as it warrants the cancellation of their membership. These are people we know therefore we tend to let them off which can only encourage such behaviour. (Male farmer interview, November 2013)

Another farmer also alleges bribery:

> People are very corrupt, some people give as much as 50,000Tsh [US$30] to irrigators so that their plots get water but you can give as little as a loaf of bread. The Management never come to inspect if the plots were watered or not and therefore this gives the opportunity for corruption to continue. (Male farmer, October 2013)

There is a range of views from the farmers within the scheme as to the 'fairness' of the systems for managing irrigation. Some people also argue that the tight schedule for pumping water is too rigid and has no flexibility. Others suggest that the flat rate of 60,000Tsh per acre is not fair, as those who only have one acre are likely to be much poorer than those with 12 acres. It is accepted by management that there are members who may have insufficient capital to pay the fees and they may be forced to rent out their plots to others.

At the start of 2014, one female farmer reported:

> There are rumours that next season each farmer will pay almost double per acre as compared to last season. It is expected to exceed 100,000Tsh per acre [nearly US$150/ha]. This will be a disaster to most of us. If we don't pay the expected amount then we will be considered ineligible and our land will be granted to other people – for that land access for us small farmers is not guaranteed. (Female farmer, January 2014)

There is no evidence of open conflict over the allocation of land within the scheme but there are allegations about membership of UWAWAKUDA, which confers access to land. It is alleged that some people have been allocated plots without having to move up the waiting list. Some families have also allegedly gained access to multiple plots by registering them to a series of relatives. One farmer expressed frustration that the farm is not for the people of Dakawa:

> For your information, there are many villagers, 'Dakawa dwellers', who are in need of land in the scheme but don't have access to it, therefore the issue of land accessibility is becoming complex as time goes on. (Female farmer, January 2014)

5.5 Conclusions: Dakawa Rice Farm

External partners have played a significant role, alongside political and business entrepreneurs, in reviving the ailing farm. It would not be operational without a significant aid subsidy from USAID (and before them JICA through TANRICE). The current aid fashions around agriculture and the location of Dakawa (a day trip from Dar es Salaam) makes it an ideal photo op for aid visitors. As one Dakawa farmer put it, "all the world is coming to Dakawa.... even the Queen of Denmark has been there." There was a rumour that Barack Obama would also visit on his recent 2013 trip to Tanzania, but this did not happen. What this signifies is the critical significance of aid in the case of Dakawa. It is therefore no surprise that UWAWAKUDA management view aid inputs as a critical part of their future development. For example, the UWAWAKUDA Chairman articulates an impressive vision for expansion of the scheme: the concreting of irrigation channels to improve water retention and efficiency; the construction of on-site storage and processing facilities; and the purchase of transport that would enable farmers to sell rice at a much higher price.

> What we need now is to find a donor who will help us to construct a processing facility and buy some lorries. Then we can go direct to the market and get better prices. (UWAWAKUDA Chairman, May 2013)

However, as noted above, it is clear from scrutiny of the farm accounts that with the current level of farmer contributions, it is unlikely that UWAWAKUDA can raise the capital for this type of development without further donor intervention.

The greatest limitation to the long-term sustainability of the scheme is the level of the Wami River. If levels are adequate, then at least two crops per year can be produced. This is the baseline assumption of donors looking at the rehabilitation of the scheme. Without this, it is doubtful that the scheme is viable. The high cost of electricity to operate the pumps is also a significant issue and a limitation in terms of cost-effective production.

Our ethnography of Dakawa thus reveals a multi-level set of narratives at play. On the one hand, Dakawa is presented as the aid-funded beacon of hope for irrigated rice production in Tanzania. In its latest incarnation, Dakawa is serving the food security and nutrition needs of local small farmers. However, this presentation of the situation is the latest in a long line of aid myth-making. Dakawa Rice Farm can stand as a signifier for the history of development and aid in Tanzania. It was built by the North Koreans, but it now has US and Chinese influence; it simultaneously empowers and marginalises women; it promotes 'small' farmers whose smallness is widely open to debate; it increases production but is not profitable; it has a model management structure but is not open and transparent; there is a emergent narrative of corruption and elite capture; and it cannot rely on the supply of the river water that it fundamentally requires to operate.

This returns us to the theme that we also found in Choma: that of incapacity and incapability of formal water management institutions to operate at a strategic level. The WRRBO is unable to regulate and control how even official and registered water users use water. The levels of the Wami River are too low to allow the Dakawa Rice Farm to operate at capacity (even allowing for the fact that the cost of electricity to run the pumps renders the cost of water too high to run the scheme sustainably in the longer term). The WRRBO issues permits for water use, can name the large water users on the river, and knows that in places the river is being diverted and the use of water is inefficient and wasteful. For Dakawa to have any long-term future as a scheme the issue of water levels in the river is of fundamental importance.

6 Conclusions

Whilst the two study locations offer examples of very different types of irrigation management structures, technology and scale, they point to the possibility of several working conclusions.

6.1 Formality and informality

The Choma case suggests that Tanzanian water policy and management institutions are not effective at dealing with the reality of institutional plurality. Instead, Choma shows informal and traditional irrigation practice simply branded as 'illegal'. The evidence suggests that despite the small scale and illegality of their irrigation, the Choma farmers are successfully able to produce commercial vegetable and fruit crops. They also show high levels of interest in organic and conservation agriculture where supported by effective local partners such as NGOs. The Tanzanian water institutions appear unable to engage at all with informal water use and the farmers themselves are resistant to being required to formalise their traditional and longstanding water use.

In Dakawa, the formality of water access by no means solves internal conflicts over the use of water. Membership of UWAWAKUDA is political and contested and a lack of transparency and accountability is in evidence despite the formal democratic and reporting structures.

6.2 Contested water use narratives

In the Choma case there appears to be a very clear contestation over the rights to water. The WaLuguru farmers who have lived in and farmed the Uluguru Mountains for centuries believe that they can use the water from the rivers without governmental interference. The wider regional hydropolitics that acknowledges that the Uluguru Mountains form the main water catchment for the Morogoro Municipality but also for Tanzania's largest city, Dar es Salaam, is significant. For some, the Choma farmers are making a good living in a difficult terrain and can be encouraged (both financially and productively) to manage their environment to conserve water. For others, the farmers are destroying and polluting important water sources and they must be moved.

In Dakawa, the right of the scheme to take water from the Wami River is not in doubt; the scheme holds an official permit. However, the levels of the Wami River have fallen to the extent that the pumping station can only be used in the rainy season and therefore the scheme cannot operate at full capacity. There is no doubt that there are increasing numbers of legitimate water users (alongside illegitimate ones), and the needs of all these users are not being met. Within the scheme itself we also see a fairness narrative around who accesses water and when. Throughout the recent history of the scheme this has proved a critical factor in the perceived effectiveness of the management and in allegations of corruption and political interference which might give preferential water access to certain farmers.

6.3 Lack of capacity to monitor and track of water use

It follows from the two points above that the serious incapacity of current formal water user institutions to monitor and regulate the water use of even legal water users is a serious limitation. This leads to the Choma farmers becoming an easy target for blame for their 'excessive use', but also to the falling levels of the Wami River from the increasing numbers of legitimate but ultimately competing users. Perhaps the most telling quotation in this working paper is the offhand comment

of the WRRBO employee who in brushing off a request for an interview said, 'we simply sell water, that is all we do.' Ultimately, this unregulated and unmonitored selling of water distorts access to and use of water resources.

6.4 Doubts over scale, efficiency and sustainability

This research is interested in how small-scale irrigation can improve farmer productivity and how farmers can receive, construct and share knowledge and information which will allow them to enhance production. In this sense, both of our study locations show some success. In Choma, the farmers produce high-value commercial crops from very small plots. This has improved their livelihoods and well-being. The success of local NGOs such as Sustainable Agriculture Tanzania in working with farmers on organic and soil conservation techniques has shown farmers to be willing to learn where techniques are low in cost and benefit their productivity.

In Dakawa, rice production levels have doubled or even tripled. Effective inputs of resources and techniques from external donors (USAID, JICA) have produced good productivity gains. Rice production is a profitable enterprise under the current Dakawa model. The increased adoption of transplanting and SRI shows that farmers are willing to learn and implement new techniques where the resources are available for them to do so.

However, in both cases, longer term sustainability is a concern. In Choma, the narrative of rights to the river water must be resolved. Ways need to be found to facilitate institutional engagement and to give the farmers a meaningful voice.

In Dakawa, inputs of aid mask and subsidise the true costs of production. Rice productivity has increased but market price has declined and therefore incomes have not risen. Many farmers take on high levels of credit to invest in rice and many struggle from year to year to obtain the inputs costs. Already, with the talk that the contribution of farmers to the scheme will have to rise, some of the bigger farmers are seeking an escape to more profitable projects. The darker politics of who really benefits from the Dakawa rice scheme also casts doubt that such grand schemes farmed by 'small farmer' co-operatives can really deliver the transformation of Tanzanian small farmer interests that they promise.

6.5 A more productive future for small-scale irrigation?

This working paper began by considering the failed promise of irrigated agriculture in sub-Saharan Africa, and more specifically in Tanzania. So do our case studies offer us scope to see a more positive future for small-scale farmers using irrigation? Can they help us to resolve some of the tensions around formality and informality in the management of water resources?

While it is clear that irrigation on a small scale can be productive, in terms of increasing production, the fundamental challenges of creating sustainable systems for irrigation do not appear to be resolved through a process of formalisation. Old power inhabits new structures and community participation in formal WUAs can easily be subverted by political and powerful interests. Perhaps the very debate on formality versus informality or even institutional plurality is a red herring?

It is possible that this is not a management problem at all, but a political one. The political question is how water resources can be shared for the greatest benefit to economic, environmental and social well-being. What priority should irrigated agriculture for the small-scale farmer have over the water demands of a private sector investor? A greater understanding of the trade-offs involved in decision-making on competing water use is required by the institutions charged with protecting and conserving water resources. Decentralistion of these decisions to community WUAs and private investors is potentially catastrophic for sustainability of the water supply. Such considerations are currently absent from irrigation policy. These political questions over prioritisation of resourcing will also require greater capacity in technical monitoring of water availability.

This returns us to the issue raised by Lockwood (2013) in the introductory section; namely that the institutional problem of water distribution (whether for agriculture or otherwise) is not located solely at the community or water source level, rather it spans different levels. Resilience and sustainability are therefore not simply community concerns but are necessarily influenced by a wider politics of resource use. Whilst the topic of transboundary water disputes certainly gets attention in the literature, it is perhaps the more meso-level intra-state politics of water that requires a careful teasing out. The full potential for irrigated agriculture to contribute to rural livelihoods cannot be realised without a more substantial political commitment to this goal.

End Notes

[1] The paper is an output from a three-country study, funded by the UK Department for International Development (DFID) and Economic and Social Research Council (ESRC) Growth Research Programme (DEGRP), covering Malawi, Tanzania and Bangladesh. The project, 'Innovations to promote growth among small-scale irrigators: an ethnographic and knowledge-exchange approach' (ES/J009414/1), is led by the University of Sussex, with partners at Bunda College of Agriculture, Malawi; Mzumbe University, Tanzania; and Jahangirnagar University, Bangladesh.

[2] By this we mean practices that are rooted in social and political arrangements that often have a long history. However, we stress that what is 'traditional' is itself subject to contestation and claim-making.

[3] Official documents and donors tend to state farm size in hectares. Farmers within the Dakawa Rice Scheme measure their plots in acres. 1ha = 2.47 acres.

References

Abernethy, C. (1994) 'Sustainability of Irrigation Systems', *Journal of Applied Irrigation Science,* 29(2):135-143

ACTI/VOCA (2013) *Congressman Garamendi Visits Feed the Future Project in Tanzania,* Washington, DC: ACDI/VOCA / http://www.acdivoca.org/site/ID/news-congressman-garamendi-visits-feed-the-future-project-in-tanzania

Adams, W., Watson, E. and Mutiso, S. (1997) 'Water, Rules and Gender: Water Rights in an Indigenous Irrigation System, Marakwet, Kenya', *Development and Change,* 28(4):707-730

Aman, H.K.R. (2005) *Making Agriculture Impact on Poverty in Tanzania: The Case of Non-Traditional Export Crops,* a paper presented at the ESRF Policy Dialogue for Accelerating Growth and Poverty Reduction in Tanzania, 12 May, Dar es Salaam, Tanzania: Economic and Social Research Foundation

Chachage, C. and Mbunda, R. (2009) *The State of the then NAFCO, NARCO, and Absentee Landlord Farms/Ranches in Tanzania,* Dar es Salaam, Tanzania: Land Rights Research and Resources Institute (HAKIARDHI)

Cleaver, F. (2012) *Development through Bricolage: Rethinking Institutions for Natural Resource Management,* London, UK: Routledge

Cooksey, B. (2013) *What Difference has CAADP Made to Tanzanian Agriculture?* Working Paper 074, Brighton, UK: Future Agricultures Consortium

Coulson, A. (2013) *Tanzania: A Political Economy,* Revised 2nd Edition, Oxford, UK: Oxford University Press

Coulson, A. (2012) *Kilimo Kwanza: A new start for Agriculture in Tanzania?*, a paper presented at the British Tanzania Society, London, UK: British Tanzania Society / ww.btsociety.org/app/images/events/kilimo_kwanza_paper.pdf

ESRF (1997) *A Framework for a National Irrigation Policy and the Economic and Social Implications for Future Irrigation Development Programmes.* Policy Dialogue Series No. 006, Dar es Salaam, Tanzania: Economic and Social Research Foundation

Garces-Restrepo, C., Vermillion, D. and Muñoz, G. (2007) *Irrigation Management Transfer: Worldwide Efforts and Results*. FAO Water Reports No. 32. Rome, Italy: Food and Agriculture Organization

Gray, R.F. (1963) *The Sonjo of Tanzania: An Anthropological Study of an Irrigation-Based Society,* London, UK: Oxford University Press for the International African Institute

Hillbom, E. (2012) 'When Water is from God: Formation of Property Rights Governing Communal Irrigation Furrows in Meru, Tanzania, c. 1890–2011', *Journal of Eastern African Studies,* 6(3)423-443

IFPRI (2000) Agriculture in Tanzania Since 1986: Follower or Leader of Growth? A World Bank Country Study. June 2000. World Bank. Washington

Igbadun, H., Mahoo, H., Tarimo, A. and Salim, B. (2006) 'Crop Water Productivity of an Irrigated Maize Crop in Mkoji Sub-Catchment of the Great Ruaha River Basin, Tanzania', *Agricultural Water Management,* 85(2006):141-150

Jenkins, B. (2012) *Mobilizing the Southern Agricultural Growth Corridor of Tanzania,* Cambridge, MA: The CSR Initiative at the Harvard Kennedy School

JICA/MoW (2013) *The Study on Water Resources Management and Development in Wami/Ruvu River Basin in the United Republic of Tanzania, Interim Report and Supporting Document 2013,* Osaka, Japan and Dar es Salaam, Tanzania: Japan International Cooperation Agency, Water Resources Division, and Ministry of Water

Kadigi, R., Mdoe, N., Ashimogo, G. and Morardet, S. (2008) 'Water for Irrigation or Hydropower Generation? Complex Questions Regarding Water Allocation in Tanzania', *Agricultural Water Management,* 95:984-992

Keraita, B., Mahoo, H., De Fraiture, C. and Tindwa, H. (2010) *Tanzania Situation Brief November 2010, Agricultural Water Management National Situation Analysis Brief,* Colombo, Sri Lanka: AgWater Solutions Project, International Water Management Institute

Komakech, H., Van der Zaag, P., Mul, M.L., Mwakalukwa, T.A. and Kemerink, J.S. (2012) 'Formalization of Water Allocation Systems and Impacts on Local Practices in the Hingilili Sub-Catchment, Tanzania', *International Journal of River Basin Management,* 10(3)213-227

Lockwood, M. (2013) 'What can Climate-Adaptation Policy in Sub-Saharan Africa Learn from Research on Governance and Politics?', *Development Policy Review,* 31(6):647-676

Maganga, F. (2003) 'Incorporating Customary Laws in Implementation of IWRM: Some Insights from Rufiji River Basin, Tanzania', *Physics and Chemistry of the Earth,* 28:995-1000

Mdee, C. (2014) *Can Irrigated Rice Production Improve Agricultural Livelihoods in Tanzania?,* MSc Dissertation, Bradford, UK: University of Bradford

Mdemu, M., Magayane, M., Lankford, B., Hatibu, N. and Kadigi, R. (2004) 'Conjoining Rainfall and Irrigation Seasonality to Enhance Productivity of Water in Rice Irrigated Farms in the Upper Ruaha River Basin, Tanzania', *Physics and Chemistry of the Earth,* 29(11): 1119-1124

Merrey, D. and Cook, S. (2012) 'Fostering Institutional Creativity at Multiple Levels: Towards Facilitated Institutional Bricolage', *Water Alternatives,* 5(1):1-19

Mutabazi, K. Wiggins, S. and Mdoe, N. (2013) *Commercialisation of African Smallholder Farming: The Case of Smallholder Farmers in Central Tanzania.* Working Paper 072, Brighton, UK: Future Agricultures Consortium

Mwakalila, S. and Noe, C. (2004) *The Use of Sustainable Irrigation for Poverty Alleviation in Tanzania: The Case of Smallholder Irrigation Schemes in Igurusi, Mbarali District.* Research Report No. 04.1, Dar es Salaam, Tanzania: Research on Poverty Alleviation (REPOA)

North, D. (1990) *Institutions, Institutional Change and Economic Performance,* Cambridge, UK: Cambridge University Press

Ostrom, E. (2005) *Understanding Institutional Diversity,* Princeton, NJ: Princeton University Press.

Ostrom, E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge, UK: Cambridge University Press

Rajabu, K. and Mahoo, H. (2008) 'Challenges of Optimal Implementation of Formal Water Rights Systems for Irrigation in the Great Ruaha Catchment in Tanzania', *Agricultural Water Management,* 95:1067-1078

Tagseth, M. (2008) 'The Expansion of Traditional Irrigation in Kilimanjaro, Tanzania', *International Journal of African Historical Studies,* 41(3)461-490

UNDP/URT (2012) *Tanzania Economic Growth: Challenges and Opportunities,* New York, NY and Dar es Salaam, Tanzania: United Nations Development Programme and United Republic of Tanzania

URT (2009a) *The National Irrigation Policy (Draft)*, Dar es Salaam, Tanzania: Ministry of Water and Irrigation

URT (2009b) *Sheria ya Usimamizi za Rasilimali za Maji No 11 ya Mwaka 2009,* Dar es Salaam, Tanzania: Ministry of Water and Irrigation

URT (2009c) *Management Plan for the Uluguru Nature Reserve, Five Years Plan, 2009/10-2013/14,* Dar es Salaam, Tanzania: Forestry and Beekeeping Division, Ministry and Natural Resources and Tourism

URT (2008) *Agriculture Sector Review and Public Expenditure Review 2008/09,* Dar es Salaam, Tanzania: Ministry of Agriculture, Food Security and Cooperation

URT (2007) *Uluguru Landscape Management Framework (ULMF),* Conservation and Management of the Eastern Arc Mountains & Forests Project, Dar es Salaam, Tanzania: Forestry and Beekeeping Division, Ministry of Natural Resources and Tourism

URT (2005) *Bankable Investment Profile: Crop and Livestock Private Sector Development (Mainland).* Report to New Partnership for Africa's Development (NEPAD) and Food and Agriculture Organization (FAO), Dar es Salaam, Tanzania: United Republic of Tanzania

USAID (1984) *Rapid Mini Appraisal of Irrigation Development Options and Investment Strategies for Tanzania/USAID.* Water Management Synthesis Project Report 23, Washington, DC: United States Agency for International Development

van Koppen, B., Giordano, M. and Butterworth, J. (2007) Community Based Water Law Water Resource Management Reform in Developing Countries, Wallingford, UK: CABI

Wiggins, S. (2013) *Agriculture and Growth in Low Income Countries: Overview of Debates and Links to Current Projects in the DFID ESRC Growth Research Programme,* London, UK: Overseas Development Institute

World Bank (2014) *Tanzania Overview: Economic Performance and Outlook,* Washington, DC: The World Bank / www.worldbank.org/en/country/tanzania/overview [accessed 6 February 2014]

You, L., Ringler, C., Wood-Sichra, U., Robertson, R., Wood, S., Zhu, T. ... and Sun, Y. (2011) 'What is the Irrigation Potential for Africa? A Combined Biophysical and Socioeconomic Approach', *Food Policy,* 36(6):770-782

Future Agricultures

This **Working Paper** was written by **Anna Mdee, Elizabeth Harrison, Chris Mdee, Erast Mdee and Elias Bahati** for the **Future Agricultures Consortium.** The FAC Working Paper series publishes work in progress by FAC members. All papers are technical research papers which have been peer reviewed, and are available in open access format. The series editors are **Paul Cox** and **Beatrice Ouma**. Further information about this series of Working Papers at: **www. future-agricultures.org**

The Future Agricultures Consortium aims to encourage critical debate and policy dialogue on the future of agriculture in Africa. The Consortium is a partnership between research-based organisations across Africa and in the UK. Future Agricultures Consortium Secretariat at the University of Sussex, Brighton BN1 9RE UK **T** +44 (0) 1273 915670 **E** info@future-agricultures.org

Funded By

UKaid from the British people

The views expressed do not necessarily reflect the UK Government's official policies.