University of Bradford- (Mzumbe)

Dissertation for MSc Economics & Finance for Development

The potential for irrigated rice production to enhance small-holder livelihoods in Tanzania

Exploring the profitability, productivity and sustainability of the Dakawa Rice Farm

Christopher Samwel Mdee

UB number: 12033574

March 2013

Abstract

After several decades of neglect, there is a renewed interest in the transformation of African agriculture; as persistent levels of poverty, rising populations and food prices, and the uncertainties of climate change all contribute to a potential future crisis for food security and a brake on economic development.

Improving the productivity and profitability of small-holder rice production is viewed as an important component of attempts to improve and develop agriculture in Tanzania, as well as to contribute to the reduction of poverty.

This dissertation explores the potential for small-scale irrigated rice production in Tanzania, and in particular it examines the profitability, productivity and sustainability of rice produced in large scale irrigation schemes, managed by co-operatives of small farmers. It does so through exploring the institutional management, the profitability and productivity of scheme members in the Dakawa Rice Farm.

Whilst the data suggests that USAID Feed the Future project inputs have helped farmers improve their productivity; there are significant concerns in relation to the politics of the farm operations, and the long-term profitability and sustainability of the scheme, relating to a range of internal and external factors. The two most crucial factors appear to be the increasing scarcity of water for irrigation and the market price that farmers can expect to receive for their rice.

Acknowledgement

I would like to express my sincere gratitude to the following people for their contribution to this study:

Dr. Andrew Mushi, my supervisor, for his continued and valuable guidance, commitment, and support throughout my study.

To the Dr Elizabeth Harrison of the University of Sussex for giving me the opportunity to participate in her study as a Research Assistant. This gave me access to primary data on the Dakawa Rice Farm. Thanks to her for giving me permission to use some of this data for my analysis. Thanks also to Dr Canford Chiroro for his insights on irrigation, data collection and analysis. Thanks also to my fellow Research Assistants, Bahati Julius and Titus Mdee for their cooperation during this study.

To George Iranga (Chairman of UWAWAKUDA) Farm Manager- Saidi Mazola, Cashier- John Kimambi, Charles Nyemele- Pump Operator, accountant Mark Kihula and all the farmers at Dakawa scheme who we had the pleasure to interview, for their transparency, cooperation and willingness to share information and personal experiences with us throughout this study.

And last but not least, to my parents, Gladness and Samwel, who have always been a source of support and encouragement to pursue my goals throughout my years of study.

DEDICATION

I would like to dedicate this study to my family:

First and foremost, my wife, Anna, for her unconditional love, support and patience, even when I happened to be unbearable and miserable due to the course works and essays, she was there to provide the all important good times and a reminder of the goals I was trying to achieve.

To my kids, Sam, Gladness and Kihara and to my step son Joseph, for putting up with my absence whilst waiting patiently for my safe return home when I have been away attending lectures.

For you all, I say: Thank You!

I declare that this dissertation is substantially my own original work and has not been submitted in any form for an award at any other academic institution. Where material has been drawn from other sources, this has been fully acknowledged.

Signature: 

Date: 6th March 2014

NOTE

The conversion rate for currencies cited in this report were approximated from the December 2013 rates:

£1 = 2500 Tsh

$1=1600 Tsh

Contents

Comment [Nathan1]: Table of content needs resetting.

Table of Contents

CHAPTER 1 Introduction

The Potential Contribution of Small Scale Irrigated Rice Production to the Agricultural Livelihood in Tanzania: A Case Study of the Dakawa Rice Farm

Agriculture has long been perceived as the back bone of Tanzania's economy. Whilst its contribution to GDP suggests figures of 25-45% depending on the source; more than 80 percent of Tanzania population continue to depend on agriculture as a whole or part of their livelihoods. Agricultural development is seen by many as a key driver in effective poverty reduction. This is an area where Tanzania has been seen to be failing despite strong economic growth in other sectors (Coulson 2012).

Since independence, the drive to commercialise and improve the productivity of agriculture has been significant, and this is no difference in the latest government initiative on agriculture, Kilimo Kwanza (Agriculture First) (Coulson 1982, 2012). Within Kilimo Kwanza, rice is cited as one of the crops with significant potential gains in productivity. Rice is the second most important crop in Tanzania both commercially and as food crop, behind maize. As such it has the potential to play an important role in terms of providing employment, income and food security for many small scale farmers in rural Tanzania, if the productivity is enhanced (RLDC 201, Barreiro-Hurle 2012, USDA 2010). In addition, not only can rice production directly improve the livelihoods of farmers, but it can have a broader beneficial impact on the rural economy through stimulating local markets, wages and rents (Filipski et al 2013).

In 2008, the Ministry of Agriculture, Food Security and Cooperatives (MoAFSC) finalised the National Rice Development Strategy (NRDS) whose aim and vision is to ensure that the subsistence dominated sub sector is transformed into commercial and viable production system (Barriero-Hurle 2012). This was a follow up to the launch of Agricultural

Sector Development Strategy (ASDS) of 2002 which was dedicated to the creation of an enabling and cooperative environment for the improvement of productivity and profitability within agricultural sector. Three common themes to these strategies appear to be that of increased productivity, profitability and irrigation intensification. Further, the Tanzanian 2009 Irrigation Policy also proposes increasing the number of large irrigation schemes, both for the benefit of small scale rice producers and for private investors (URT 2009) This dissertation seeks to explore the potential for increased rice production, through a case study of the Dakawa Rice Farm, a former state farm, now managed by a Small Farmers' Co-operative.

Research Question and Objectives

This dissertation aims to explore the potential contribution of irrigated rice production for improving the agricultural livelihoods of small farmers in Tanzania. In order to achieve this research will explore three main themes: productivity, profitability and sustainability of irrigation intensification around small scale rice production, specifically trying to answer the following questions:

- What is the potential contribution of small scale irrigated rice production to agricultural livelihoods in Tanzania?
- How profitable is the rice produced in irrigation schemes?
- How sustainable is of smallholder irrigated rice production?

Methodology

This dissertation combines a mixed methods approach to research (Bryman 2006) and includes secondary and primary data on the profitability, productivity and sustainability of rice production in Tanzania. It firstly explores the policy and programmatic literature on rice production and then examines a case study developed with primary data- the Dakawa Rice Farm in the Morogoro Region of Tanzania.

Secondary literature was sourced from the academic journals, books and research papers from relevant policy institutes (such as REPOA, IFPRI). A number of private consulting

firms appear to be engaged in improving rice production in Tanzania and their materials have also been sourced.

Policy documents and reports on irrigation and agriculture were obtained from the Ministry of Agriculture, Food Security and Co-operatives, as well as the Ministry of Water and Irrigation. Further information on rice tariffs have been sought from the Tanzania Revenue Authority and Ministry of Finance. A number of donors, including JICA and USAID, are investing in improving rice productivity in Tanzania and their materials have also been reviewed.

The literature review of this dissertation enabled the construction of an analytical framework to be applied to the case study of the Dakawa Rice Farm.

The Dakawa scheme was chosen as a case study as it illustrates well Tanzania's current approach to developing irrigated agricultural production. Dakawa Rice Farm appears to have been the site of repeated aid interventions throughout its history and is currently the focus of USAID and Chinese projects. The farm has something of a chequered political history but is currently cited as an example of how irrigated rice productivity can benefit small farmers.

Primary data collection on productivity, profitability and sustainability was carried out in Dakawa irrigation scheme farm for another research project from June 2013- January 2014 period using a survey, semi-structured interviews, and key informant interviews. I was part of a Research Team gathering field data for an ESRC-DFID project by the University of Sussex on the politics of smallholder irrigation. I was not part of the team authoring the outputs for the Sussex project and my analysis is authored independently for the purposes of my dissertation. Permission was granted by the Principal Investigator, Dr Elizabeth Harrison, to use the original primary data to do a further in-depth analysis of rice production. Baseline data from the University of Sussex study (a questionnaire of 115 farmers and a range of key informant interviews on the scheme operations) were used to purposively select 10-15 Farmers for in-depth financial interviews. The purposive selection was used to cover farmers with different sizes of land holding. In-depth financial interviews were also conducted with the Accountant of Dakawa Rice Farm and the accounts of the Co-operative Society of Farmers were also examined.

The purpose of the in-depth financial interviews was to explore two main things: 1) the productivity and profitability of rice production of individual farmers and 2) the sustainability of the scheme.

The study also used key informant interviews (KIIs) with USAID and Staff members of the Dakawa Rice Farm, a focus group discussion (FGD) of scheme members and field observation in order to triangulate the scheme member's data. Interview guides were used during the primary data collection process for consistency. The interviews and surveys were done in Kiswahili and verbal informed consent was requested from participants. Interview notes were simultaneously transcribed into English.

The data produced was both quantitative and qualitative. Financial and production information from Farmers, and from staff of the Dakawa Rice Farm, have been used to conduct a financial analysis of profitability and sustainability of the scheme. Thematic analysis of qualitative data from interviews was used to identify internal and external factors which shape the productivity, profitability and sustainability of the Dakawa Rice Farm.

Research Limitations

There are many contributing factors for the poor productivity that small scale farmers are facing such as fertilisers, seeds, pest control, extension services, credit availability, reliability and market storage etc. Lack of irrigation has been identified as a fundamental factor for increasing productivity and profitability. For instance, it is well documented that irrigated rice produces as much as four time more of the amount that can be produced under rain fed conditions (Keraita et al 2010). Therefore, although these other contributing factors will be analysed briefly, this dissertation will mainly focus on irrigation. The dissertation is also limited by using only one case study, therefore conclusions will be tentative and exploratory rather than statistically generalisable.

The remainder of the dissertation will be structured as follows: chapter 2 presents a critical analysis of literature on agricultural transformation and rice production in Tanzania. It particularly focuses on aspects of profitability, productivity and sustainability in order to build a conceptual framework through which to explore the case study of Dakawa Rice Farm. Chapter 3 sets out to explore the background and institutional set up of the Dakawa

Rice Farm. It covers the operation of the scheme, explores key stakeholders and provides a contextual analysis of water availability for irrigation. Chapter 4 analyses financial aspects of productivity and profitability for farmers with different sizes of land holdings. It also considers the financial viability of the Dakawa Rice Farm as a whole. Chapter 5 draws together lessons from the case study and seeks to answer the research questions posed in the dissertation. It concludes with an analysis of the internal and external factors which appear to shape the productivity, profitability and sustainability of a scheme such as the one in Dakawa.

CHAPTER 2 – Small-scale irrigated rice production: can it be productive, profitable and sustainable?

This chapter sets out the theoretical and empirical background for dissertation. It explores the role of agriculture in poverty reduction and considers measures to enhance the livelihoods of small farmers. It then moves to explore irrigated rice production as a means to enhance the livelihoods of small-scale producers. Issues of productivity, profitability and sustainability of current irrigation initiatives are considered. The chapter seeks to both identify gaps in the literature and to construct a conceptual framework for the study, which can be used to analyse the case study of Dakawa Rice Farm.

Agriculture, poverty and the small farmer

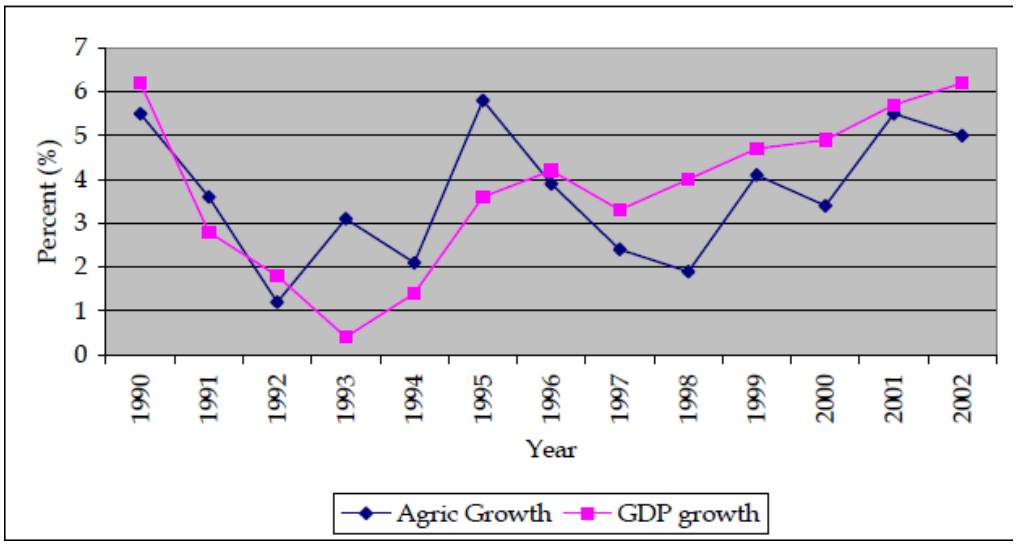
Despite the emergence and development of industries such as mining, tourism and services in Tanzanian economic growth, agriculture continues to be a significant component due to the number of poor it employs and also the strong consumption linkages it has with other sectors (Aman 2005, Coulson 2012, Jenkins 2012).

The exact proportion of what agriculture contributes to Tanzanian GDP is not universally agreed but ranges from estimates of 25% (UNDP 2012) to around 45% of the total GDP (Keraita et al, 2010), and 30% of export earnings (Keraita et al, 2010) to 85% of export earnings (UNDP 2012). However, what most sources are agreed on is that agriculture continues to provide a significant proportion of the livelihoods of 80% of the population (Keraita et al 2010, UNDP 2012, Coulson 2011, 2012). Therefore supporting agricultural development offers not only pathways for the nation's economic prosperity, but also contributes to poverty reduction efforts (URT 2005).

The World Bank (URT/WB 2000) suggests 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 around 11% annually. Agricultural growth in Tanzania has been significantly below this figure. Aman (2005) points out that Tanzania set a lower target agricultural growth rate of 5 percent by 2003, which was achieved in 2001 with rate of 5.5 followed by a slight dip of 5 percent in 2002. The figure below shows

agriculture and GDP growth rate up to 2002.

Figure 1: Trends in Annual Agriculture growth and Real GDP



Source: Aman 2005:P4

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%. Figure 2 below shows that apart from higher rates recorded in 2001 and 2002, we can clearly see a consistent low annual growth rate of about 4% throughout, which suggests that lack of progress in the sector.

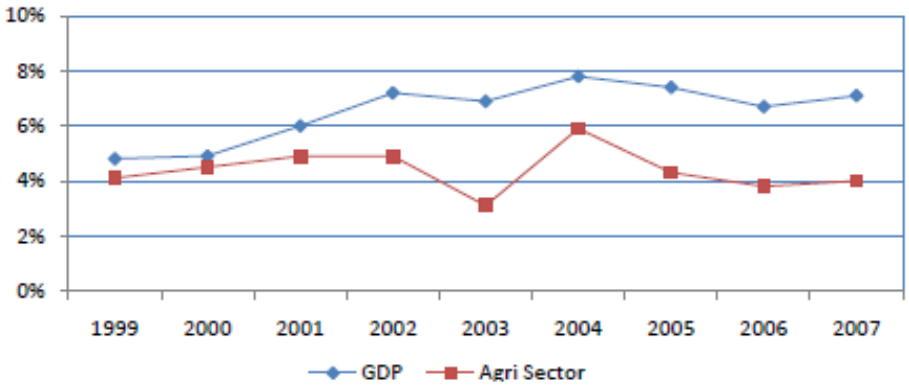


Figure 2: Annual growth rates in GDP and Agricultural sector period 1998 to 2007 ***Source : URT 2008 : P10***

Analysts such as Keraita et al (2010), Aman (2005) & Jenkins (2012) have pointed to a varied range of constraints that prohibit the optimal level of production in agricultural sector. Among those constraints 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, as yet there is not a 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) reveals that only 300,000 hectares (ha) out of a potential 5.1 million ha are 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 a Kilimo Kwanza 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).

Irrigated rice production- the potential for improving the livelihoods of small farmers?

One crop identified in Kilimo Kwanza as having potential for increased production is rice. Rice cultivation takes place on estimated 681,000 ha of arable land, which is equivalent to 18 % of the total cultivated land and is mainly concentrated in Shinyanga, Mwanza, Tabora, Mbeya and Morogoro Regions of Tanzania, where at least 281,000 farmers are believed to be actively involved (ECI 2003, Jenkins 2012 & RLDC 2011). Value chain analysis suggests that more than 35 rice related cash transactions are taking place from the production to reaching final consumption, which makes rice an important crop for stimulating linked economic activities (Filipiski et al 2013).

However the productivity of rice continues to pose a challenge for the average farmer. Ninety eight percent of rice farmers are small scale farmers, cultivating an average of less

than 2.5 ha each. Although there are small village level traditional collective farmers, and a few small to medium scale modern irrigated farms, rice production is mostly rain fed. In total only 29 percent of the total rice grown is under irrigation and the remaining 71 percent is produced under rain-fed conditions (Jenkins 2012).

Evidence suggests that the relationship between irrigation and rice productivity is critical. AllAfrica (2013) reports the impact of irrigation in rice production in Mabogini – Moshi where small scale farmers have increased their irrigation area from 300 to 1600 hectares whilst witnessing their rice production doubled from 3 to 6t/ha in the process making the area the biggest rice producer in the country[1].

Moreover, JICA (2013) elaborate this further by pointing to the extent of which irrigation has played in increasing rice production in Tanzania. They cite three irrigation schemes, i.e. Kitivo in Tanga, and Kiroko and Ilonga both in Morogoro. JICA (ibid) states that since the initiation of TANRICE training in 2007 (alongside irrigation), Kitivo's production has increased from 2.9 t/ha in 2007 to 5.1 t/ha in 2013 whilst between 2007 and 2009 Kiroko and Ilonga have both experienced an increase of 2.1 and 3.4 t/ha to 3.6 and 4.9 t/ha respectively.

Evidence of the impact of irrigation on rice productivity is not only found in Tanzania. The baseline research that was carried out by Wan Abbas et al (2004) in Lampung Province of Indonesia concluded that the rice productivity under rain fed conditions was lower than that produced under irrigation, even when both are undertaken using the same farming technology. However they also stressed the need for caution whilst studying their results by pointing to the facts that other factors such as severe droughts, extensive use of inputs i.e. fertiliser and the degree of water control measures more often than not will account for observed productivity differences. For instance, the observation showed that for the two rice production season – wet and dry seasons applied in Lampung, yields in a wet season was 5.12 t/ha and 3.6 t/ha in irrigated and rain fed respectively compared to 4.79 and 2.03 t/ha in dry season for irrigated and rain fed respectively.

Tanzania views irrigated agriculture as one mechanism in their focus on modernising production. Rwenyemamu (2009) emphasises that the Tanzania's Poverty Reduction

[1] http://allafrica.com/stories/201308260425.html, accessed 6th February 2014

Strategy Paper of 2005 clearly states that irrigation is to be the key in pushing the transformation of Tanzania's agriculture for poverty alleviation and food security attainment. Further there appears to be political will in boosting rice production while protecting local farmers market through various rural initiatives and import tariffs. According to Therkildsen (2011) it was agreed in the Agricultural Sector Development Programme paper that 1 million hectares of irrigation expansion land was identified for development within a 5 year period under the stewardship of local government authorities. Concurrently, the East African Community imposed a Common External Tariff to protect local farmers from cheap imported rice (USDA 2011).

President Jakaya Kikwete announced the 1 million irrigation expansion initiative in his election campaign of 2005, but implementation has been challenging. It is also suggested that substantial smuggling of cheap rice is still taking place through Zanzibar, which impacts on the price of local rice. In addition, irrigation scheme sustainability is considered low due to poor operational management and maintenance (Therkildsen 2011).

Irrigation Schemes and Sustainability

The Tanzanian Irrigation Policy emphasises the use of formal irrigation 'schemes' as the main 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 to most of the initiatives that the government through ASDP has endeavoured 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 (Abernethy 1994, URT 2009a). Such shortcomings and failings are not unique to Tanzania but are found as a challenge in irrigation worldwide (Mawakila & Noe 2004, Wiggins 2013).

In recent years however, we have been able to see a rejuvenated vigour and strong interest in support for irrigation, and in particular with small scale farmers, from developmental organisations like the World Bank, FAO and 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 government 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 is important: most donor and government-supported irrigation is based on the assumption that formal management organizations are essential. 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 & Mahoo 2008, Igbadum et al 2006,Mdemu et al 2004, Maganga et al 2003, ESRF 1997,). These sources argue that current institutional management of irrigation usually lacks the capacity to optimise water use.

Rice Market and Profitability

There is little point in scaling up rice production if the enterprise does not generate profits and therefore can move small scale farmers from subsistence production.

According to Nyange and Morrison (2005) Tanzania is the biggest rice producer in East Africa and the second in Southern Africa just behind Madagascar (USDA 2011). However, the exact tonnage demanded and supplied is difficult to establish. Scenarios such as left-over rice from previous seasons, and also imported and then re-exported rice make it difficult to establish the exact amount of rice available for consumption. However as recent as of May 2013, the Tanzania Minister of Agriculture stated that "Tanzania's current rice production capacity stands at around 1.2 million tons, of which around 300,000 tons of rice is exported to other countries" (oryza.com 2013). Meanwhile USDA (2011) forecast that, the rice production in Tanzania for the year 2013-14 would be at around 990,000 tons which is slightly lower than government estimates, but forecast that a total supplies of around 140,000 tons will be imported.

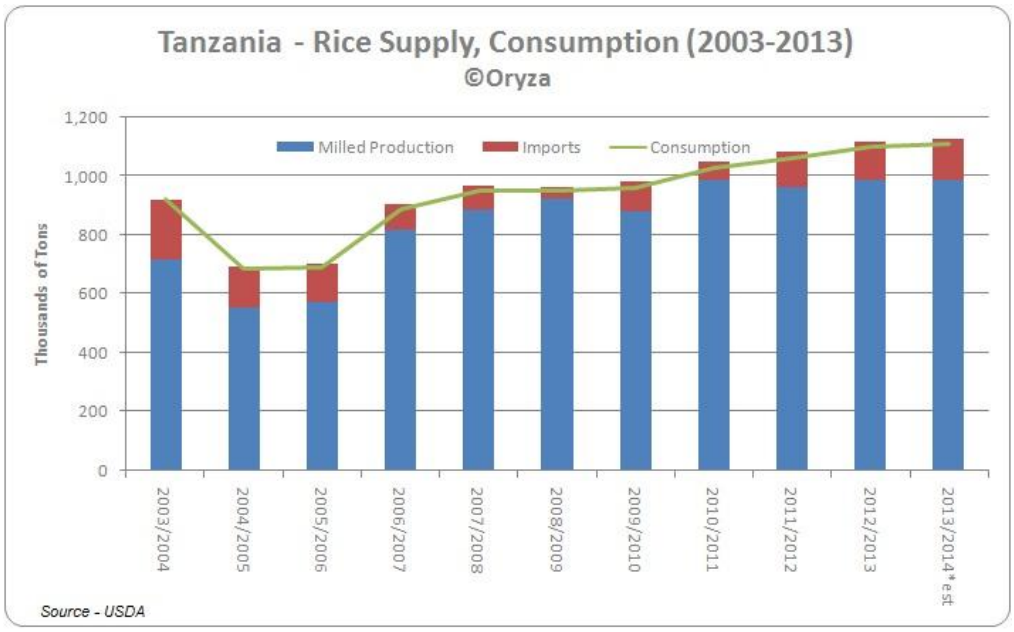


Figure 3-Rice Production in Tanzania, source: USDA 2011:3

It is argued by some that the market for rice remains unfulfilled from local production as a large proportion of rice that is produced is consumed on the farm in the rural areas, despite the high demand and therefore better prices available in urban areas such as Dar es Salaam and Arusha (RLDC 2011). JICA (2013) suggests that Tanzanian local rice production cannot keep up with the ever increasing demand and is therefore forced into importing in order to keep up with the supply. The future demand for rice looks even better for local producers with the anticipated increase in both urbanisation and also rice consumption increase from domestic, region and global market combined with their respective price market (Therkildsen 2011 & Jenkins 2012). However, there is a warning from Therkildsen that illegal imports of rice from East Asia entering the market via Zanzibar undermine the farm gate price for rice. Conversely, USDA (2011) suggests that the East African Community Protective Tariffs artificially inflate the price for rice (harming consumers but helping producers) and create false market incentives. They argue that as the local market is saturated, this will lead to lower prices being received by farmers and this will potentially cause a drop in production.

Whilst the prospect of increased demand and production is obvious, the actual profitability

of rice to individual farmers under different farming systems is an area that needs further research. Kadigi et al (2008) while comparing the four paddy / rice irrigation systems, carried a baseline research to explore their returns to labour, profit margins and the value of the irrigation water used under each system at Usangu basin in Tanzania. From the combination of primary and secondary data collected from the study area, they calculated the gross margin and return to labour using the current price. The table 1 below summarises their findings

Table 1: Comparison of Profit Margin and returns to labour in Usangu basin for 2004 source Kadigi et al 2008:989

Table 1 – Inputs costs, revenues, productivity and value of water in paddy production for five types of farming systems in the Great Ruaha River Catchment, Tanzania, 2004

	Type 1 (rainfed subsistence farmers)	Type 2 (rainfed paddy growers with high inputs)	Type 3 (irrigated paddy growers on NAFCO plots)	Type 4 (small irrigated paddy growers with high inputs)	Type 5 (small irrigated paddy growers with low inputs)
Farm/plot size (ha)	0.35	0.54	6	1.27	1.25
Paddy price (Tsh/kg)	144	144	144	144	144
Yield (kg/ha)	818	1,575	1,600	3,028	2,500
Gross income (Tsh/ha)	117,580	226,390	229,980	435,270	359,360
Operational costs:					
Plot renting (Tsh/ha)	0	0	30,000	30,000	25,000
Seeds (Tsh/ha)	6,570	6,570	9,920	8,580	8,250
Fertilizer (Tsh/ha)	0	14,930	22,740	19,370	0
Tractor hiring charge (Tsh/ha)	0	24,310	30,000	20,670	0
Hired labour (Tsh/ha)	0	58,230	62,200	77,930	0
Bags and twine (Tsh/ha)	5,900	10,860	11,670	22,070	6,040
Transport (Tsh/ha)	7,960	7,960	16,000	29,600	24,800
Financial costs (10% of expenses) (Tsh/ha)	2,040	12,290	18,250	20,820	6,410
Total operational costs (Tsh/ha)	22,470	135,150	200,780	229,040	70,500
Gross margin (Tsh/ha)	95,110	91,240	29,200	206,230	288,860
Gross return to an average plot (Tsh)	33,300	49,300	175,200	261,900	361,100
Family labour (mandays/ha)	206	183	102	113	167
Hired labour (mandays/ha)	0	39	41	52	0
Gross return on family labour (Tsh/manday)	462	499	286	1,825	1,730
Productivity of withdrawn water (kg/m^3)[a]	0.130	0.250	0.059	0.148	0.117
Productivity of consumed water (kg/m^3)[a]	0.138	0.265	0.126	0.259	0.210
Value of withdrawn water (Tsh/m^3)[a]	21.78	27.66	4.27	17.82	19.45
Value of consumed water (Tsh/m^3)[a]	23.11	29.35	9.08	31.19	35.09

The exchange rate in April 2003 was US$ 1 = Tsh 1063.62.
[a] Averages calculated over the 1994–2003 period.

From the table above, it is evident that different rice production systems yield different results in terms of returns to labour and also profit margins. The conclusion they drew from their findings is that while both systems had a positive returns to their respective smallholder farmers, on average those farmers outside NAFCO (state farm) scheme set up (type IV above) who had invested in activities such as irrigation, tractorization, use of fertiliser and hired labour had a higher return to labour and attracted the highest gross margin per hectare compared to the other rice farming systems. They also noted that

smallholder farmer (type I) who cultivated under rain fed whilst using hand hoe and depended exclusively on family labour obtained the smallest returns to labour. It is also interesting to see that, from their observation, the smallholder farmer under NAFCO scheme (type III) ended up earning the smallest gross margin. This is an important consideration for the case study of Dakawa which is also a former NAFCO farm.

A number of reasons contribute to these apparent differences in both productivity and profitability among the small scale rice production systems. While in part, the extent to which commercial inputs are used and the economies of scale differences can take the blame (Kadigi et at 2008), It has also been noted that small scale irrigation is hampered by a lack of marketing infrastructure, low levels of capital, inappropriate technologies, limited extension capacity, weak support from government, and 'dependency mentality' and 'risk aversion' among farmers (Kadigi et al 2008, Jenkins 2012)

Clearly rice production has the potential to be a profitable and dynamic sub-sector with the capacity to contribute to small scale households farmers and to their livelihoods. Even within small scale farmer circles, there is an evident recognition and are alluded to the fact that rice production gives them a better returns than any other crop within those rice producing regions (Yanda et al 2005). However those returns can further be enhanced. Currently, the costs of rice production plus other arrays of issues ranging from tariffs charged by the government on imports and exports and costs of transport, are too high and therefore erode the profit margins that could have been realized by the farmers (Feed the Future 2012). Feed the Future (ibid) argues that things like encouraging large scale agricultural investment are critical in driving technological adaptation and improved market which will consequently improve farmers' profit margins. In substantiating their claim, they plan to facilitate around 5000 smallholder farmer in an irrigation scheme in Kilombero – Morogoro though a capacity building programme which they hope will help to increase the farmers income by twelve fold. Hamilton (2010) also supports this conclusion in a USAID funded assessment for increasing production of maize and rice in Tanzania.

Conclusion and conceptual framework for the study

This chapter began by considering the pressing need for Tanzania to increase growth in agricultural livelihoods. Performance in this area has been relatively weak in comparison to the strong economic growth in other sectors of the economy. Therefore it is crucial that

the 80% of the Tanzania population who depend on agriculture are given opportunities to improve their livelihoods. This potentially has positive impacts on wider poverty reduction.

The chapter then examined the potential for increased small-holder rice production in Tanzania. It found evidence that most current rice production is small scale and rain-fed. Current data suggests that there are significant productivity and profitability gains for farmers through irrigated rice production, alongside the use of improved technology, access to credit and markets etc.

There are some potential caveats, one of which is under certainty in relation to the market price for rice. There is some suggestion that prices received by farmers will fall in future which will potentially damage profitability. There is also some concern that illegal importation of rice from East Asia is already undermining the price received by farmers.

At the level of sustainability, there are difficult questions around resource use and management. There is a considerable literature on irrigation management which engages with the complexity and scale of water resource management; and there is plenty of evidence that mismanagement has often led to the potential gains from irrigation being unrealised. Irrigation politics in terms of fair access to water for scheme members is also crucial for the sustainability of irrigation schemes.

All these themes will be explored further through the case study of Dakawa Rice Farm.

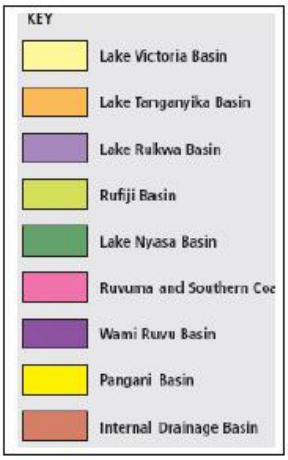
CHAPTER 3 – The Case study: Dakawa Rice Farm, Mvomero District

Introduction

This chapter provides a contextual background to Dakawa Rice Farm. Formerly a state rice farm under the National Farming Company (NAFCO) built by North Korea, the 2000 hectare irrigated Dakawa Rice Farm is now managed as a co-operative of small farmers (UWAWAKUDA). This chapter will explore the physical, political and institutional evolution of the Farm as these all provide an important context to assessing issues of productivity, profitability and sustainability in irrigation rice production for small-holder farmers. It is based on a survey of 115 farmers as well as key informant interviews and secondary literature.

Dakawa is a settlement located approx 40km from the City of Morogoro on the road to Dodoma. It is in the Wami-Ruvu River Basin and sits close to the Wami River (see map1 below). It is the site of one of the largest irrigated rice schemes in Tanzania, with 2000 hectares of paddy. Morogoro Region is a central part of current initiatives to create the Southern Agricultural Growth Corridor (SAGCOT) and therefore there are significant levels of aid funded and commercial activities established in the area (Jenkins 2012).

Map 1: River Basins of Tanzania



Source: URT (2007)

Rainfall is bi-modal with the long rains in the March-May period and short rains from October-December. This is significant in terms of the level of flow of the Wami river as will become clear in the analysis below.

Livelihoods

A 2013 survey of 115 farmers in Dakawa for a current University of Sussex project indicates that livelihoods are predominantly agricultural, the full survey results are listed in appendix 1. 51% rely on agriculture only. The other 49% combine agriculture with other activities: 35% of all respondents operate a small business (such as shops and bars), 9% are livestock keepers and 5% also have formal paid employment. The predominant crop is irrigated rice paddy with 78% of survey households doing this. On dry land, 47% of farmers produce maize and 16% rice with small numbers also producing tomatoes, leafy veg and other crops.

Dakawa is a relatively new settlement with an agricultural population centred on the irrigated 2000-hectare[2] rice farm. The survey indicates that 77% had not lived in the area for all of their lives with the most common period of settlement being in the 2000s. Interview respondents confirm that the population fluctuates in relation to the labour demands of paddy production, and that all the ethnic groups of Tanzania can be found there. There are significant numbers of Masai pastoralists in the area and tensions over

[2] In this report official documents and donors tend to state farm size in hectares. Farmers within the Dakawa Rice Scheme measure their plots in acres (1 hectare = 2.47 acres)

access to land and damage to crops are common.

Dakawa is said to be ward (Kata) in the Tanzanian Local Government System but does not appear as such in the 2012 Census Report (URT 2013). Local government changes appear to have caused confusion and ward officials could not explain why Dakawa was not listed as a ward in the recent census. They thought perhaps it had been put into the Mvomero ward- this is listed as having a population of 37,321. Clearly Dakawa village only has a fraction of this population but the village office does not have accurate or current data. Estimates at the village level suggest a population of around 8000 people.

Land Tenure and Land Use

Farmers in the area tend to have a combination of land within the irrigated scheme and outside of it. Land outside of the scheme is used for rain-fed agriculture. The 2013 survey calculated the average total land holding as 5.76 acres with 3.5 acres average of irrigated land and 2.2 acres of dry land. Irrigated land is predominantly within the control of the cooperative rice farm. Land within the rice farm is accessed by membership of the water users' association. Dry land is a roughly equal split of freehold and leasehold.

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.

Using satellite imagery the scale of the Dakawa farm can be seen: http://www.maplandia.com/tanzania/morogoro/morogoro/dakawa-6-26-0-s-37-32-0-e/

The settlement of Dakawa runs to the north from the Morogoro-Dodoma Road. The Dakawa Rice Farm sits to the right of the settlement alongside the Wami River. The water pumping station is at the southern tip of the farm.

The historic background of Dakawa Rice Farm

The Dakawa Rice Farm was originally a state rice farm and was built in 1981 with aid from North Korea. The farm in this period was under NAFCO (Chachage & Mbunda 2009). The farm was build to high technical specifications and consists of 12-acre blocks connected by a series of intersecting irrigation canals. Throughout the history of the scheme there have been doubts as to whether the farm could operate at full capacity

(USAID 1984). Water is drawn from the Wami River by a pumping station.

NAFCO collapsed in 1996 and the farms under its control were sold or transferred to the Parastatal Sector Reform Commission (PSRC). Before this, farmers with long residency in Dakawa report that NAFCO was bankrupt years earlier and the farm was unused for a period of 10 years.

After the intervention of PSRC, the farm was given to a number of high profile police or political figures ('the group of 6'), they invited other villagers to join them and an organisation called DAKCOP emerged in 1999 to take over the farm. At this time PSRC issued a letter to order the farm to be handed over to the villagers of Dakawa. The then District Commissioner ordered the farm to be divided between the Dakawa Village Council, Government Officers and DAKCOP. This led to the breakup of DAKCOP and *Ushirika wa Wakulima Wadogo Wadogo Dakawa* (translated as Society of Small Farmers in Dakawa (UWAWAKUDA) was established. This is a co-operative society regulated by the Societies Act as described in TCI (2006). This period coincides with the increase in population in Dakawa.

The first Chairman was unelected after two years as members were not satisfied that some plots were inaccessible and did not receive water.
The second Chairman, elected in 2005/6 for two years was accused of giving plots to more than 1 person.
"At this point the Village Council decided that they wanted to take control of the farm and they installed Mzee U to become the Chairman." Farmer M (interview)
Mr U, whose wife, VU is featured heavily in recent donor project publicity on Dakawa, is now accused of corruption and mismanagement:

"Another conflict emerged because water availability became scarcer and people who paid their money to get the plot didn't get any. Also, 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". Farmer M (interview)

Following an investigation, Mr U was removed and the current leadership (Chairman with other Ministry appointees as Deputy Chair, Bursar, Farm Manager and Pump Attendant

were installed for a period of 3 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." Farmer M (interview)

It may be significant that this period coincides with external intervention by USAID under the 'Feed the Future' Programme which has considerable inputs for increasing farmer productivity. Work on clearing irrigation channels and a feasibility study for the replacement of the existing pumps has also been undertaken. Informal comments from project engineers suggest that the replacement of the pumps may not happen as the level of the Wami River will not sustain the cost effective operation of the pumps.
External partners have played a significant role alongside the political and business entrepreneurs in reviving the ailing NAFCO farm. The farm would not be operational without a significant aid subsidy from USAID and JICA before them under the TANRICE project. The current aid fashions around the revival of agriculture and the location of Dakawa (a day trip from Dar-es-Salaam) makes it an ideal location for photo opportunities for bilateral donors, foreign ministries and Tanzanian politicians.

As retired Dakawa Dairy Farmer, CN stated:
All the world is coming to Dakawa....even the Queen of Denmark has been there'

There was rumour that Barack Obama would also visit on his 2013 trip to Tanzania but this did not happen (however the US ambassador has been)

The USAID NAFAKA (under the Feed the Future programme) project has facilitated study tours, access to grants, loans etc, all of which have changed the way farmers are cultivating. Fertiliser and Chemical companies also play a role and farmers may be able to purchase inputs on credit.

The Chinese are also present in Dakawa through their 62 hectare agricultural research and learning facility. The facility Director, reports that Chinese hybrid varieties of rice have huge production potential outstripping the best locally available hybrids (such as Saro 5). They run residential courses for 300 farmers per year since they began operation in 2010. When asked why the Chinese chose to come to Dakawa- his reply was, the Government of Tanzania had told them to come there

"They told us to come and they promised us that we would have our own water supply from the Wami River, but that has never happened. So we had to dig our own boreholes and we are only using a small part of our land as there is not enough water.
The trouble is that ***you people*** *(pointing a finger at me!) want something for nothing. You cannot get anything good from the land unless you will put water there and do agriculture properly. I have seen several Ministers of Agriculture here and also I have told the President. They all promise that the water will be brought here but nothing has ever happened. I am not interested where they get the water from*".

4 years of waiting and isolation in Dakawa and frustration with the government had clearly frustrated the Director of this partnership project.

Irrigation and Agricultural Institutions in Dakawa

All farmers with irrigated land in this area are part of the 2000 hectares of the Dakawa Rice Farm. To access land within the scheme an individual must obtain membership of UWAWAKUDA. The plots within the farm are divided into 12 acres blocks and the maximum plot of land that can be farmed by one person is 12 acres. Some 12 acres blocks are farmed by more than one family given capacity constraints (hence the average of 3.5 acres per farmer in the University of Sussex survey). However, it is reported that some families and other well connect politicians and civil servants use several blocks of 12 acres by registering the blocks under the names of different family members.

Under the formal rules of the scheme all farmers are members of the UWAWAKUDA and can apply to become members of the Board which oversees the operation of the irrigation scheme. All members are entitled to attend the 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, having paid a membership fee and bough shares (referred to as HISA). There is currently a waiting list for membership. To become a member you need to have 10 shares (HISA) and these are 10,000Tsh (£4) each. The current Chairman of the Board is also an Agronomist at the nearby Chollima Research Centre. The Board employ a professional Farm Manager to supervise the pumping operations. Members of UWAWAKUDA currently pay 60,000Tsh (£24) per acre per year to cover the cost of electricity to operate the pumping station.

The Management are responsible for the maintenance of the main canals and the pumping of the water- these are in theory covered by the fees paid by members. Whilst within the 12 acres plots, the users of these plots 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 into the plots.

Current membership is given as 954 farmers. Outside of the UWAWAKUDA scheme, a very small number of farmers of approximately 1% use their own private arrangements to draw water from the Wami river (small pumps) or by borehole.

Although it works with all these agricultural agencies, UWAWAKUDA remains an independent organisation, but the history shows influence by the Dakawa Village Council and also from the Ministry of Agriculture, Food Security and Co-operatives, the latter who currently constitute the Management Team for the farm. Extension inputs through JICA, USAID, CRC and the Chinese Centre are mentioned as significant but these do not interfere with the operation of UWAWAKUDA.

Water Sources and reliability

The flow of the Wami river is critical to the viability of the Dakawa Rice Farm. Prof Andrew Tarimo of Sokoine University of Agriculture began his career as manager of the farm under NAFCO and asserts that the farm has never run at full capacity. Currently the flow of the Wami only allows the pumps to draw water in the wet season (March-June). The Wami-Ruvu River Basin Office oversees the use of water from the Wami River and can issue water rights. The water right incurred by the scheme for the year 2011 and 2012 were Tsh 8,980,000 and 8,830,000 respectively (UWAWAKUDA accounts 2013). All the water for the Dakawa Rice Farm is taken by pumping station from the Wami River, which flows through Dakawa.

A substantial cost (15 million Tsh (£6000 per month) is paid to TANESCO for electricity each month (UWAWAKUDA accounts 2013) in the pumping season. A USAID-funded project is underway to rehabilitate and install new pumps in the pumping station to make this operation more efficient. Informal conversations with personnel connected to this project suggest that it has been severely delayed and suggested government interference in the awarding of the contract for the purchase of new pumps.

A number of interviewees report that the flow of the Wami River restricts the operation of the scheme. In 2013 only one crop of rice has been cultivated as the level of the river is too low to run the pumps. This is attributed to competition from upstream users including large commercial investors who are also taking water from the Wami.
Water extraction from the river is in theory regulated by the Wami-Ruvu River Basin Office. Although an anonymous official at the Morogoro Head Office said he didn't need to be interviewed as his job was very simple: "We are just here to sell the water".

Another 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 (URT 2009b). He is also responsible for enforcing this act but said that no one has yet been prosecuted under it.
"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".

In practice, interviews suggest that regulation of water use is not effective and has led to upstream users drawing too much water which has led to the reduction in the flow of the Wami.
Some interviewees suggest that in order to the Dakawa Rice Farm to be sustainable, much stronger regulation, compliance and punishment would be required for large water users upstream. This was confirmed in an interview with the Director of the Wami-Ruvu River Basin Office and further supports concerns raised by Rajabu & Mahoo (2008) in other irrigation schemes, that extraction levels are not monitored.
In relation to the wider issue of access to land and water in the Wami River catchment- the big landholders in the surrounding area are alleged to be big political/business figures, for example former Kenyan Prime Minister, Raila Odinga. This is also noted in the HakiArdhi 2009 Report on the fate of the NAFCO and NARCO farms and ranches (Chachage & Mbunda 2009)

Rules within the UWAWAKUDA scheme for water usage are highly formalised. The Board makes decisions on when water will be pumped, and the cycle by which it reaches the different blocks. However, interviews indicate that there are instances of bribery whereby some people may have been able to access water ahead of others. Irrigation water is

pumped according to a cycle agreed by the Farm Manager and the Board. 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. Given the problems with the level of the Wami River, in the 2013 season, water was pumped to the farms from April-July. There are four sections to the farm and gates across the irrigation canals that are opened and shut to control the flow of the water. It was reported that the timing of the flow can disadvantage those farmers with plots at the furthest corner as by the time they receive the water, the weather is already becoming colder (June/July).

Farmers within each 12 acre block need to decide collectively when they will open the gates to water the plot. They can make this decision when the water is flowing to their section of the farm. Anyone who is found to be stealing water can be expelled from UWAWAKUDA.

Despite the dissatisfaction expressed by some, generally interviews with farmers for the University of Sussex research project indicated that 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 for water sharing in the scheme 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.

"A big shot might call up the Farm Manager from Dar and tell him to send the water to his plot" GI -Current Chairman

Whilst it is said that this situation can no longer happen and some farmers interviewed expressed a high level of trust and confidence in the current management; there were others who allege that political water allocations and access to plots within the scheme are highly politicised.

One anonymous senior source connected to USAID expressed the view that most farmers were in reality labourers for big landowners who owned multiple plots despite the rules regulating access to land in the scheme.

Another reported limitation of this system is where a number of Farmers share a 12-acre plot and they may be at different stages of cultivation or may use different methods of rice production (broadcasting vs transplanting) and so they may require water at different stages. Some Farmers may also be more organised than others.

Farmers within the blocks must have a high degree of cooperation. A number of Farmers reported that there is an issue with this. Some said that they had worked with their co-plot holders for a number of years and so they had a high level of co-operation and trust. They could meet together and agree when they need to allow the water into the plot

"I do trust those I share the plot and water with, we cooperate in terms of ploughing, sowing and irrigating together, They are people who I have known and shared the plot with for a long time" Farmer BM

However, most Farmers also cited this arrangement as being the reason for conflicts and disagreements.

Levels of trust between plot holders clearly vary as the shown in the quotation below:

"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." Farmer CK

There is also some jealousy that certain individuals appear to be given preferential access to loans and study tours. Some people also argue that the tight schedule for pumping water is too rigid and has no flexibility. Others also argued that the flat rate of 60,000Tsh per acre is not fair as those who only have 1 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.

Conclusion

The Dakawa Rice Farm has a turbulent political history. It has never operated at full capacity and is currently only able to produce one crop of irrigated rice per year given the low levels of the Wami River. The management of the scheme also shows some difficulties. Whilst formal systems are in place for access to land and sharing of water, in practice there appears to be a suggestion that the rules can be used to benefit wealthy farmers who own multiple plots. There is also little effective and efficient management of

water in the scheme. The current management acknowledge high levels of water loss given the poor unlined state of irrigation canals and the very variable nature of individual 12-acre blocks.

The physical and political issues in relation to the Dakawa Rice Farm do raise concerns for its long-term viability and sustainability (Abernethy 1994).

CHAPTER 4

Rice productivity and profitability in Dakawa- a financial analysis

Introduction

The aim of the chapter is to explore the productivity and profitability of rice production under current conditions. It also considers the relationship between this and the viability of UWAWAKUDA as a co-operative society.

This chapter is based on interviews with 10 farmers purposively selected to represent different sizes of land holding. The farmers were interviewed in detail in order to estimate their costs of production and to assess their yields and sales of rice. The data covers the 2013 cropping season. In addition, an in-depth interview with the UWAWAKUDA accountant provided access to the Society accounts.

Productivity of irrigated rice in Dakawa

Farmers within the scheme express their general satisfaction with the efficiency and effectiveness of their own production. They are able to articulate significant recent gains in productivity through access to better seed, fertilisers and improved cultivation techniques through USAID(NAFAKA project under the 'Feed the Future' initiative), Chollima Research Centre and their own efforts . They also express that water sharing within some limitations is as fair as it can be given the current limitations in pumping operations. General interviews with farmers under the University of Sussex study report the potential to get up to 45 bags (weighing between 80 and 100 kg) of rice per acre with current irrigation and techniques (roughly 4.5 tonnes per hectare). This is roughly the same level of production as cited in JICA (2013) above. A number of farmers report productivity gains of 3 x previous production levels. A critical component of this has been the adoption of the 'system of rice intensification' a method which emphasises the effective use of water, increasing skills of farmers to incorporate biomass, manage crop protection and promote the transplanting of rice seedlings. Uphoff (2003) and Sato & Uphoff (2007) claim great value in the method for improving productivity in small-scale agricultural intensification.

The application of this approach by USAID in Dakawa has also clearly brought productivity increases for farmers who have adopted the methods.
Formal membership of UWAWAKUDA also allows members to access credit to purchase inputs and labour in the growing season (for example the microfinance provider 'Opportunity Tanzania') works in partnership with the Farm Office). This is another potentially critical factor in enabling farmers to uptake new methods and technologies. Nakano & Kajisa (2013) suggest that credit can be particularly important in allowing bigger farmers to pay for labour intensive processes such as seedling transplanting.

However, a number of farmers also report that whereas in 2012 they were able to get 100,000Tsh (£40) per bag of rice, in the 2013 season they have received between Tsh 50,000Tsh (£20) in July and Tsh 45,000 in December. Therefore the increasing productivity has been offset by the decline in price. The majority if not all of the rice produced is sold at the Farm gate with buyers coming to Dakawa. The Farm currently has no storage facilities, processing capacity or transport. This is cited as something required to increase the profitability of the scheme.

Many farmers reported that the good productivity in the scheme contributes to improvements in the family diet and income. However, one female farmer (CK) 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."*

This quote suggests that the benefits of production may not be shared within the family and therefore we cannot assume that increased productivity leads to improved well-being for the wider household.
Some farmers reported that rain fed land could produce greater profits on rice production (than the irrigated land) in a good year, as the land outside the scheme could be farmed with lower inputs and so had a lower production cost. To investigate this claim further and to better understand the profitability levels of the farmers I collected financial data, which included the cost of production of one acre rain fed and irrigated land with their corresponding productivity. Table 2 below shows the results.
The six farmers shown in the table are selected from the 10 financial interviews as they farmed rice under both irrigated and raid-fed conditions.

	Farida Zaharani		Chetu Kolongo		Mwajabu Haji		Fanuel Mbaji		Simon Sunza		Mbaruku Salum	
	Irrigated land 3 acres	Rain fed land 3 acres	Irrigated land 4 acres	Rain fed land 1 acres	Irrigated land 3 acres	Rain fed land 1 acres	Irrigated land 2 acres	Rain fed land 2 acres	Irrigated land 1 acres	Rain fed land 3 acres	Irrigated land 10 acres	Rain fed land 10 acres
Land rent		20,000		30,000		30,000		40,000		40,000		
Corporative development fee	5,000		5,000		5,000		5,000		5,000		5,000	
Village development fee	2,000		2,000		2,000		2,000		2,000		2,000	
Water	60,000		60,000		60,000		60,000		60,000		60,000	
Ploughing	40,000	40,000	40,000	45,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Preparing Furrows/Ridges	30,000		30,000		30,000		30,000		30,000		30,000	
Harrowing 1	30,000	30,000		25,000	25,000	20,000		20,000		30,000	30,000	30,000
Levelling			45,000				80,000		50,000			
Seedbed / Nursery Prep.			5,000		3,000		5,000		30,000			
Seed 16Kg	33,000	25,000	90,000	40,000	33,000	25,000	30,000	20,000	30,000	30,000	60,000	45,000
Harrowing 2	30,000			25,000							30,000	
Seed broadcasting	15,000	10,000		5,000		10,000		20,000		5,000	10,000	10,000
Transplanting			100,000		80,000		80,000		80,000			
Fertilizer 1 + labour DAP (50kg)	76,000		74,000		74,000		160,000		61,000		135,000	
Herbicide + labour (24D) 1lt									21,000	21,000	23,000	23,000
Weeding 1	60,000	60,000	11,000	70,000	20,000	10,000	10,000	40,000	40,000	50,000	80,000	70,000
Insecticide (1lt)												
Fertilizer 2 + labour (Urea) 50kg	67,000		74,000		74,000		75,000		67,000		135,000	
Weeding 2	80,000	42,000	20,000	70,000	20,000	10,000	10,000	40,000	30,000	50,000	150,000	70,000
Fertilizer 3 + labour (Urea) 50kg	67,000		74,000		74,000				67,000			
Weeding 3		30,000	20,000					40,000			180,000	70,000
Bird Scaring		50,000						80,000	80,000	50,000	70,000	70,000
Bags For Harvest	20,300	11,669	17,825	8,060	10,500	7,000	14,000		16,250	13,000	14,000	5,600
Harvesting	100,000	80,000	80,000	90,000	80,000	50,000	80,000		70,000	70,000	100,000	80,000
Loading and Unloading	43,500	33,340	71,875	19,500	22,500	15,000	40,000		37,500	30,000	40,000	12,000
Transport (Field to Drying)	43,500	33,340	71,875	19,500	22,500	15,000	40,000	8,000	50,000	40,000	30,000	12,000
Drying	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Milling									62,500	50,000		
Storage (3 Months)	58,000	33,340										
Cost of loan												
Total production cost	**910,300**	**548,689**	**941,575**	**497,060**	**725,500**	**282,000**	**811,000**	**398,000**	**979,250**	**569,000**	**1,274,000**	**587,600**
Total yield per acre	29	17	29	13	15	10	20	4	25	20	20	8
Average selling price per bag	47,500	75,000	62,000	70,000	47,500	60,000	47,500	60,000	65,000	70,000	47,500	70,000
Total Revenue per acre	**1,377,500**	**1,250,250**	**1,782,500**	**910,000**	**712,500**	**600,000**	**950,000**	**240,000**	**1,625,000**	**1,400,000**	**950,000**	**560,000**
Profit per acre	**467,200**	**701,561**	**840,925**	**412,940**	**-13,000**	**318,000**	**139,000**	**-158,000**	**645,750**	**831,000**	**-324,000**	**-27,600**

Table 2- Costs of Production and profits of selected farmers in Dakawa comparing irrigated and rain-fed production source: interview data

From the table 2 above, we can see that the average Cost of Production (COP) per acre for the rain fed land is Tsh 480,392 where as for the irrigated land comes to Tsh 920,348. However when we look at the profit generated from rain fed and irrigated land, contrary to what the majority of farmer who were interviewed said, we find an interesting observation as irrigated land produced a better average profit per acre of Tsh 390,500 compared to Tsh 346,317 generated by the rain fed land despite rain fed rice attracting better price of Tsh 67,500 per bag compare to Tsh 51,375 per bag of irrigated rice. This result is largely due to the productivity differences where on average irrigated land yield was 26 bags per acre while rain fed produced 12 bags per acre.

The average figures obscure quite a level of variability. The range of profit generated per acre for irrigated land is from 139,000 Tsh up to 840,925 Tsh. It should be noted that one farmer (Mbaraku Salum- the largest landholder in the group) made significant losses. He explained that this was due to the erroneous application of a chemical supplied by a Chinese sales agent which led to the total loss of his first crop. He was forced to plant again.

The table shows that irrigated rice production is profitable for the individual farmers even with a land holding of only 1 acre. As farmers reported, their productivity in the 2013 season had increased but the price received per bag of rice had halved, so the full benefits of productivity increases are not realised. This appears to be in line with the suggestion made by USDA (2013) that the price for rice would fall as the local demand was saturated. Informal comments from one larger farmer (VU) suggested that she was already considering starting her own irrigated vegetable production, as rice was no longer profitable enough to be attractive and to safely cover the cost of credit taken for production. It would be interesting to further analyse these incentives for farmers but this is not in the scope of this research.

Table 3 Cost of Rice Production- Tanzania 2009 Source: Hamilton (2010:17)

ESTIMATED COST OF RICE PRODUCTION

Notes	System Inputs	Qty/ha	Traditional Price/Unit	Cost/ha	Qty/ha	Improved Price/Unit	Cost/ha
1	Seeds	200	$0.38	$75.19	200	$1.128	$225.56
2	Fertilizer (basal)	2000	$0.01	$15.04	5	$20.676	$103.38
3	Top dressing				2.5	$24.436	$61.09
4	Pesticides						$22.56
5	Labor (man days)						
	Land preparation	16	$1.50	$24.00	16	$1.500	$24.00
	Seeding	2	$1.50	$3.00	2	$1.500	$3.00
	Thinning	10	$1.50	$15.00	10	$1.500	$15.00
	1st-3rd weeding	48	$1.50	$72.00	48	$1.500	$72.00
	Harvesting	16	$1.50	$24.00	35	$1.500	$52.50
6	Transport	3	$2.00	$6.00	7	$2.000	$14.00
	Total			**$234.23**			**593.09**
7	Yield kg/ha			1300			3200
	Cost per 100 kg			18.01735			18.53419
	Cost per short ton			163.45065			168.13934

Sources:
1. Data provided by Kibaya DALDO.
2. Traditional use of 1 MT/ha manure, improved use of 250 kg/ha Minjingo phosphate.
3. Improved use of 125 kg/ha Urea.
4. Use of Actellic dust on stored grain.
5. Estimated unskilled wage.
6. Higher cost includes hire of oxcart.
7. Traditional yield is five-year average; improved yield is level required to achieve similar cost/bag to traditional system.

Box 1- comment on rice pricing- Hamilton 2010:14

DOMESTIC RICE MARKET PROTECTION IN TANZANIA

Although substantial volumes of rice are produced in Tanzania, the domestic crop is not particularly price competitive in the local market. In January 2010, Thai A1 Super rice (a low-quality rice) could be imported at a CIF price of US$445/MT, as compared with domestic rice selling in Dar at US$750/MT for low grade and US$970/MT for best quality rice. In a price-sensitive market, local rice would lose out to the imported product were it not for the 75 percent duty imposed on rice imported into Tanzania. This raises the price of Thai A1 Super to US$756/MT and allows the local product to compete.

There is a market for Tanzanian rice, both domestically and internationally, based upon its particular aromatic and taste qualities. However, this is a high-value market of limited volume and is insufficient to absorb the current level of production in Tanzania. Without the current tariff in rice imports, both domestic and export prices would fall substantially.

The figures from Dakawa are very comparable with the estimated cost of rice production as detailed from a USAID-funded study published in 2010. It gives the cost of improved irrigated production as $593 (889,500 Tsh). This compares to the average production cost of 920,000 Tsh found in the sample of Dakawa farmers. Production in the 2010 for improved irrigated production is 3200 kg per ha (1,259 per acre). The average yield of the sample of farmers in this research is 26 bags per acre. We can assume that 1 bag is 100kg, therefore this would be 2600Kg per acre (6604 kg per hectare). This appears to be a very high level of productivity but does compare to the reported levels in the Moshi scheme as reported by All Africa (2013).

Had the price of rice received by farmers remained at the 2012 level then they would have seen big income gains. However, the fall in the price of rice reported by farmers has undermined a potentially substantial rise in productivity. USDA (2013) predicts that once productivity increased and demand for local rice was met then falls in price could follow and some farmers would decrease their

production. Box 1 predicts that the nature of the local market for rice could depress prices substantially if it were not for the EAC tariff of 75%. However, as Therkildsen (2011) reports there are substantial quantities of rice entering the country illegally often via Zanzibar. He suggests that politically it works for the government to ignore this smuggling as it reduces the price of rice for the urban voters. Hamilton (2010) further suggests that the nature of the rice value chain, particularly the lack of capacity for producers to store, mill and transport their product to market weakens their trading position and they tend to accept whatever price the rice traders will give them. As already noted, the UWAWAKUDA notes this weakness and is seeking 'donors' to plug the gap. This leads us to the question of the purpose and viability of UWAWAKUDA.

Is UWAWAKUDA viable as a co-operative?

Aside from the profitability of the individual farmers, there is a question of institutional efficiency and effectiveness of UWAWAKUDA. An interview with UWAWAKUDA Chairman GI articulated an impressive vision for expansion of the scheme, for 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 direct to the wholesale markets in the cities. However, with the current level of farmer contributions set at 60,000 Tsh per acre (see table 4 below), it is unlikely that UWAWAKUDA can raise the capital for this type of development without further donor intervention.

From table 4 below we can see that whilst the year 2011 the scheme operated within its means, the following year 2012 the scheme overspent by Tsh 43million. There was no way of knowing the position for the year 2013 but the feeling expressed by the management is that the loss might even surpass that of 2012.

Item description	31 December 2012	31 December 2013
Revenue		
Water fees	154,257,000	212,249,500
Membership fees	400,000	
Application form	80,000	
Corporative development fees	18,209,000	29,542,950
Other income	61,083,550	83,077,547
Total revenue	**234,029,550**	**324,869,997**
Expenditure		
Non Operational costs		
Salaries / Wages	32,449,000	24,837,000
office and stationeries	2,077,900	2,415,610
Communication	1,947,000	792,000
Identification Cards		1,350,000
Audit	40,000	80,000
Training	4,091,500	
Tanzania Revenue Authority	1,271,700	1,080,000
Damaging birds control	710,000	596,000
Solicitors	5,600,000	4,000,000
Farm measuring	110,000	
Farm lease	5,401,200	
Travel allowances	13,212,345	12,864,810
Computer equipments	120,000	
Board Expenses	7,797,900	7,846,400
Meetings	4,565,600	2,090,000
Banking cost		821,712
Guests and visitors	1,012,700	1,852,300
Other expenses	3,110,600	2,697,000
	83,517,445	**63,322,832**
Maintenance costs		
Pump repair & maintenance	36,876,700	28,474,675
Canals repairs & maintenance	7,273,700	5,411,000
Wear and Tear	57,566,520	58,857,950
Repair bags	400,000	200,000
Oil for pumps	100,000	
Inspections	688,600	1,911,000
	102,905,520	**94,854,625**
Operational costs		
Wami Ruvu basin water right	8,830,000	8,980,000
Repair of Motorbikes	1,497,850	1,337,445
Electricity bill main office	2,166,422	
Water controllers wages	7,848,000	7,180,000
Electricity bill pumps	71,190,236	31,973,975
	91,532,508	**49,471,420**
Total expenditure	**277,955,473**	**207,648,877**
Profit / Loss	**-43,925,923**	**117,221,120**

Table 4: Revenue versus Operational and maintenance cost for the year 2011 and 2012 Source: UWAWAKUDA Accounts.

By breaking down individual costs, the high operational and maintenance cost of the scheme appear to be a significant issue for the scheme and a limitation in terms of cost effectiveness in production. For instance the year 2012, it cost over Tsh 194 million in operational and maintenance costs whilst the money received from farmers for water usage was only 154 million. It appears as though there was a significant increase in salaries in 2012 as well as a more than doubling in the cost of electricity rising from 31 million in 2011 to more than 70 million Tsh in 2012. On this basis, it would therefore appear that the scheme will not be sustainable in long term if the source of income is to solely come from internal resources alone.

There is a suggestion that increased revenues could be raised from farmers by increasing the per acre water charge to 100,000Tsh. The analysis of profitability in table 2 suggests that farmers could easily absorb such an increase. However, this increase is politically difficult to sell to members, some of whom were already complaining that they could not afford it.

The way in which money from donors enters the scheme is not clear from the accounts.

Insufficient detail and transparency is available to make a judgement on this. However, it is clear that many within the scheme are looking to donors to fund operational expansion and routine maintenance.

The organisation of small farmers into co-operative societies is in theory supposed to lead to gains in terms of their being able to command better prices in the market place and also to collectively invest (TFC 2006). As it currently stands, it does not appear as though UWAWAKUDA can fulfil this role without external aid. Therefore it is important to question its long term sustainability and viability. If you add this to the concern that not all farmers in Dakawa are actually small farmers (but well-connected individuals using the system to access irrigated land), then a cynical view might be that the co-operative identity is being used as a means to attract inputs from donors for already well-off individuals. More investigation is required to ascertain if this perception is correct.

CHAPTER 5 Conclusion

The potential for irrigated rice schemes to transform agricultural livelihoods

Through the case study of Dakawa Rice Farm operated by the UWAWAKUDA co-operative, this dissertation sought to answer the following questions.

- What is the potential contribution of small scale irrigated rice production to agricultural livelihoods in Tanzania?
- How profitable rice produced in irrigation schemes?
- How sustainable is smallholder irrigated rice production?

The literature review in chapter 2 suggests donors, researchers and the Government of Tanzania see considerable potential for irrigated rice production to improve small-holder livelihoods (Jenkins 2012, Hamilton 2010, Therkildsen 2011, URT 2009a, Coulson 2012)
Figures show that irrigated rice production can produce excellent yields, and decrease the risks associated with rain-fed production. The case study in Dakawa confirms that with the right support, the productivity of farmers can be substantially increased. In this case the system of rice intensification delivered through the USAID NAFAKA project has led to farmers reporting a doubling and tripling of production. This should lead to improvements in the livelihoods of farmers as we would expect their incomes to grow. However, this research suggests that the picture is more complex than this.

For those who can access land within the Dakawa Rice Farm and have sufficient capital, knowledge and inputs to farm it then production can be excellent.
However, in the key informant interviews and mentioned by some farmers was a broader problem that some people did not know how to use the income they gained. Some farmers were accused of drinking their profits and failing to invest in inputs for the following year. One research from the Chollima Research Centre went as far as to argue that he believed a special research project was required to look at this ‘cultural problem’.

Potential gains from irrigation are not being maximised as the scheme is not able to run at capacity given the water shortage. In addition, the low price offered for rice in the 2013 year erodes the positive impacts of irrigation.

Is the small-scale farmer really that small?

As the title of dissertation states, the aim is to explore the role of irrigated rice production to the livelihood of "small farmers" Now, for a long period there have been differences of opinion in relation to the issue of 'smallness' within the Dakawa Rice Farm as described in chapter 3. The registration of several plots to the same families (using relatives names) is seen by some as subverting the ethos of 'smallness' and preventing poorer farmers from accessing the scheme. However, one Water Engineer with experience of Dakawa over several decades argues that at least those with large acreages can afford to invest in the irrigation infrastructure- such as concreting channels. Large owners in this view are successful entrepreneurs. On the other hand if you accept this argument then the stated purpose of such a scheme (small-holder livelihoods enhancement) is undermined as it benefits the larger farmers to receive aid subsidised inputs for production in the name of small farmers. This also goes to the heart of the debate in the theoretical literature on agricultural development on the feasibility of agriculture being transformed through small-holders rather than commercialised farmers (Coulson 2012, 2013)

In relation to the second question on factors on profitability: we can see assessments of cost of production in the literature such as Hamilton (2010) suggests that irrigated rice production is profitable. The level of profitability depends to a great degree on the cost of production, level of production and the market price received.

In this research the focus was on the irrigated land rather than dry land production. However, some farmers in Dakawa believed that in good years (heavy rains) that the dry land is better for productivity and cost of production (especially if you don't have investment capital). This as it turned out, on the basis of the financial assessment (refer table 2) is not the case. However, having irrigated land meant you are assured of getting a crop if you have done the work and have capital to buy inputs.

Whilst some external interviewees expressed doubt that the scheme was cost effective given that it is not running at full capacity- the farmers seem to be satisfied that they can guarantee at least one good crop per year. They have always lived with uncertainty on the dry land- rainfall has always fluctuated. So on dry land they plant a range of crops to spread the risk.

A more substantial threat to profitability is the market price received by farmers. This is discussed in detail in chapters 3 and 4. As confirmed by the literature (USDA 2013 and Hamilton 2010), the price for locally produced rice had been artificially inflated by EAC protective tariffs. The data from Dakawa shows that the price farmers received for their rice in 2013 had halved from the levels received in 2012. The weak market position of UWAWAKUDA in addition to the dynamics of the rice market suggests that profitability has been undermined by market price falls. However, irrigated rice production is still evidently profitable for the small-scale farmer. It is potentially significant that one larger farmer suggests that rice is no longer profitable enough for her and she is looking for another aid project to allow her to move into irrigated vegetable production. This would require further investigation to confirm the impact of market price falls on the level of production by different farmers.

Whilst individual farmers within the UWAWAKUDA Rice Farm have increased their productivity and are able to generate profits, there are significant questions concerning the long-term sustainability of the scheme itself. Abernethy (1994) argues that 'institutional health' of a scheme is critical and that sustainability is dynamic relating to ' physical, socio-economic, financial, environmental and political factors'. The literature in chapter 2 (e.g. Maganga et al 2003) also underpins the critical important of effective management in irrigation institutions). Using Abernethy's list of five factors and considering data from chapters 3 and 4, it is worrying that there are concerns over sustainability in each dimension:

Physical: the infrastructure of the irrigation scheme is inefficient and aging. The water pumps require replacement. There is no rice storage or milling capacity in the scheme.
Socio-economic: rice prices are unstable, some farmers appear to be unable to effectively invest in inputs and are trapped in a cycle of credit, or lose access to land.
Financial: UWAWAKUDA as a scheme is not profitable; it cannot generate sufficient capital to make physical investment. It is dependent on aid projects.
Environmental: the flow of the Wami River is decreasing due to upstream demand. This limits the capacity of the Dakawa Rice Farm. There is no effective institutional mechanism for resolving competing water demands (the River Basin Office has insufficient resources).
Political: As chapter 3 describes Dakawa Rice Farm operations have always been political since its creation as a state farm and now as a site of aid for the Government, USAID and China. A whole dissertation could have been written on this issue alone. Most

crucially for this research we see a politics of ‘smallness’ at play. UWAWAKUDA is a co-operative for small farmers and yet a range of stakeholders believe that those benefiting most are large politically connected farmers using UWAWAKUDA as a means to receive aid subsidised inputs. This dissertation cannot resolve this issue but needs to acknowledge it as a significant factor.

Given that each of Abernethy’s factors of sustainability contain serious concerns in relation to Dakawa it is necessary to conclude that its long-term sustainability does not seem assured. None of these issues can be considered to be unique to Dakawa, but are likely to be repeated in other irrigation schemes. They raise serious concerns as to the viability of small-scale farmer rice production within irrigation schemes.

Therefore to conclude, irrigation can improve the productivity of rice production, this production can also be profitable for small farmers, however, the mechanisms and management of irrigation institutions remains crucial. Perhaps even more crucial are issues of competing water use at catchment level, and how decisions will be made and resolved as to whom water is available to and in what quantities (see Kadigi et al 2008). Without this, irrigated rice production may prove impossible in the longer term.

References

Abernethy, C. (1994) Sustainability of Irrigation Systems, Zeitschrift fur Bewasserungswirtschaft, 29, Jahrgang, Heft 2/1994, Seite 135-143,

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

Barreiro-Hurle, J. (2012) *Analysis of incentives and disincentives for rice in the United Republic of Tanzania,*. Technical notes series, MAFAP, FAO, Rome

Bryman, A. *(*2006*).* Integrating quantitative and qualitative research: How is it done*? Qualitative Research,* 6, 97-113

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

Coulson, A. (1982) Tanzania- A Political Economy, Oxford, Oxford University Press

Coulson, A. (2012) Kilimo Kwanza. A new start for Agriculture in Tanzania? Talk given to the British Tanzania Society, London. Available at http://www.bts.org.uk

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

ECI (2003) *Rice Sub-Sector Study*, Development Alternatives Inc, Private Enterprise Support Activities Project, Tanzania, Produced by Ebony Consulting International Ltd), South Africa

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, Economic and Social Research Foundation, Dar-es-Salaam, Tanzania

Feed the Future (2012) *Feed the Future Helps Improve Rice Production in Southern Agriculture Growth Corridor of Tanzania* http://feedthefuture.gov/article/feed-future-helps-improve-rice-production-southern-agriculture-growth-corridor-tanzania - Accessed on 10/01/2014

Filipski, M., Manning, D., Taylor, J. E., Diao, X., & Pradesha, A. (2013) *Evaluating the Local Economywide Impacts of Irrigation Projects*, Feed the Future in Tanzania, IFPRI Discussion Paper 01247, Institute for Food Policy Research.

Garces-Restrepo, C.; Vermillion, D. and Muñoz, G. (2007) *Irrigation management transfer: Worldwide efforts and results*. FAO Water Reports No. 32. Rome: FAO

Hamilton, B. (2010) *MicroCLIR/CIBER Assessment, The legal, policy, regulatory, and institutional constraints to the growth of maize and rice in Tanzania*, Produced for USAID.

Igbadun, H., Mahoo, H., Tarimo, A., & 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): 141-50

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

JICA (2013a) http://www.jica.go.jp/tanzania/english/activities/agriculture_07.html - Accessed on 15/01/2014

JICA/MoW (2013b) *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*, Japan International Cooperation Agency (JICA), Water Resources Division, Ministry of Water

Kadigi, R., Mdoe, N., Ashimogo, G. & Morardet, S. (2008) Water for irrigation or hydropower generation? Complex questions regarding water allocation in Tanzania, *Agricultural Water Management* 95 (2008): 984-92

Keraita, B., Mahoo, H. De Fraiture, C., & Tindwa, H. (2010) *Tanzania Situation Brief November 2010, Agricultural Water Management National Situation Analysis Brief*, AgWater Solutions, International Water Management Institute

Kissawike, K. (2008) *Irrigation--based Livelihood Challenges and Opportunities: A gendered technography of irrigation development intervention in the Lower Moshi irrigation scheme in Tanzania*, Unpublished PhD thesis, Netherlands: University of Wageningen

Maganga, F. (2003) Incorporating customary laws in implementation of IWRM: some insights from Rufiji River Basin, Tanzania, Physics and Chemistry of the Earth 28(2003): 995-1000

Mdemu, M., Magayane, M., Lankford, B., Hatibu, N. & 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 & Chemistry of the Earth* 29(2004) 11: 1119-24

Mwakalila, S. & 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, Research on Poverty Alleviation (REPOA) , Dar es Salaam, Mkuki na Nyota

Nakano, Y. & Kajisa, K. (2013) *The Determinants of Technology Adoption: The Case of the Rice Sector in Tanzania*, Research Paper No.58 March 2013, Tokyo, JICA Research Institute

Nyange, D. and Morrison, J. 2005. *Extent and Impact of Food Import Surges: The Case of Tanzania. Final Report*. April 2006. FAO. Rome

Rajabu, K. & 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(2008): 1067-78

RIDC (2009) Rice Sector Strategy: *Improving Rice Profitability through increased Productivity and Better Marketing Focusing on Tanzania's Central Corridor*, Rural Livelihoods Development Company (November 2009).

Rowhani, P., Lobell, D. Linderman, M. & Ramankutty, N. (2011) Climate variability and crop production in Tanzania, *Agricultural and Forest Meteorology* 151 (2011) 449-460

Rweyemamu, D. (2009) *Strategies for Growth and Poverty Reduction: Has Tanzania's Second PRSP Influenced Implementation? EPP Working Paper*. 2009: 13. Danish Institute for International Studies. Copenhagen.

Sato, S. & Uphoff, N. (2007) *Raising Factor Productivity in Irrigated Rice Production: Opportunities with the System of Rice Intensification*, CABI 2007

Tanzanian Federation of Cooperatives (TFC) (2006) *Cooperatives and Development in Tanzania: A*

Simplified Guide to the Cooperative Development Policy and the Cooperative Societies Act of Tanzania Mainland. Dar es Salaam

Tanzania Investment Centre (n.d.) *Tanzania Investors Guide (Vol. 255)*, Dar-es-Salaam, Tanzania Investment Centre

Therkildsen, O. (2011) Policy *making and implementation in agriculture: Tanzania's push for irrigated rice*, DIIS Working Paper 2011:26, Copenhagen: Danish Institute for International Studies

Uphoff, N. (2003). Higher yields with fewer external inputs? The System of Rice Intensification and potential contributions to agricultural sustainability, *International Journal of Agricultural Sustainability* 1, 38-50

UNDP (2012) *Tanzania Economic Growth- Challenges and Opportunities*, United Nations Development Programme with United Republic of Tanzania, Dar-es-Salaam.

URT (2007) *National Adaptation Programme of Action (NAPA). Vice President's Office, Division of Environment*, United Republic of Tanzania

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

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

URT (2009b) *Sheria ya Usimamizi za Rasilimali za Maji No 11 ya Mwaka 2009*, Ministry of Water & Irrigation (produced with support of WWF/EU)

URT (2013) *National Census 2012*, Dar-es-Salaam: Ministry of Finance, Government of the United Republic of Tanzania

URT (2005) with NEPAD and FAO, NEPAD–CAADP Bankable Investment Profile, *"Crop and Livestock Private Sector Development" Volume IV of VII,* Addis Ababa, African Union, Comprehensive African Agricultural Development Plan

USAID (1984) *Rapid Mini Appraisal of Irrigation Development Options and Investment Strategies for Tanzania/USAID*, Water Management Synthesis Project WMS Report 23, Washington

USDA (2012) *EAC Rice Import Tariffs and Food Security Update*, Global Agriculture Information Network Report 26/4/2012, Nariobi

Wan Abbas, Z., Dyah Aring, H. & Yaktiworo, I. (2004) *The Impact of Irrigation Development on Rice Production in Lampung Province, Research Report*, Bandur Lampung, University of Lampung

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: Overseas Development Institute.

World Bank (2000): *Agriculture in Tanzania Since 1986: Follower or Leader of Growth*; IFPRI, Washington.

World Bank (2014) *Tanzania Overview- Economic Performance and Outlook*, Available at http://www.worldbank.org/en/country/tanzania/overview last accessed 6th February 2014

Yanda, P.Z, Majule, A. E. and Mwakaje, A.G (2005) *Wetland Utilisation, Poverty Alleviation and Environmental Conservation in Semi rid Areas of Tanzania – The case of Singida Region*. Dar es Salaam

You L , Ringler C , Wood-Sichra U , Robertson R, Wood S, Zhu T, Nelson G, Guo Z, Sun Y. (2011) What is the irrigation potential for Africa? A combined biophysical and socioeconomic approach, *Food Policy*, 36(6), p.770-782

Appendix 1 Key Informant Interviews

Name	Institution/title	Dates
George M. Iranga Agronomist	Chollima Research Centre/Chairman UWAWAKUDA	31/5/2013- Dakawa
Prof Chen Hualin	Demonstration Centre of China Agricultural Technology in Tanzania	17/09/2013- Dakawa Brochure obtained
Joseph John	Agricultural Research Officer-Chollima Research Centre	17/09/2013
Mnyika Yuda	Farmer-Dakawa	19/09/2013
Mulokozi	Farmer-Dakawa	19/09/2013
	Ward Executive Officer-Dakawa	20/09/2013
Charles Haule	Farmer-Dakawa	20/09/2013
Wilson Mashauri	Farmer-Dakawa	20/09/2013
Ayubu Ajajili Mwalukula	Farmer-Dakawa	20/09/2013
Benson Mangula	Farmer-Dakawa	19/09/2013
Christina Kesuke	Farmer-Dakawa	19/09/2013
Matola	Farmer-Dakawa	21/09/2013
Paul Edward	Farmer/Businessman	21/09/2013
Nasha Ritalilu	Agricultural Field Officer-horticulture	22/09/2013
Mwanahamisi/Mama Mshale	Farmers	22/09/2013
Joseph Ramess and Mama	Farmers	21/09/2013
Hamisi Maskini	Wami-Ruvu River Basin Authority Ward Office Secretary of Water Distribution Committee	8/10/2013
Veronica Urio	Farmer	13/11/2013
Chris Hall	Engineer- Mott MacDonald/USAID	Informal discussions

Appendix 2 Focused Group Discussions

18/09/2013- Farmers- Baraka Mwakasasa, Said Mohammed Alimas, Boniface Nzali (conducted by Elias Bahati)

22/09/2013- Farm Manager- Saidi Mazola, Cashier- John Kimambi, Charles Nyemele- Pump Operator (All three also farm within the scheme and are members of UWAWAKUDA

Appendix 3 Financial interviews

Name	Irrigated land (Acrage)	Rainfed land (Acrage)
Farida Zaharani	3	3
Chetu Kolongo	4	1
Mwajabu Haji	3	1
Fanuel Mbaji	2	2
Simon Sunza	1	3
Mbaruku Salum	10	10
Nuru Mbonge	4	0
Piason Msanya	5	0
Hassan Haji	6	0
Suleiman Mfaume	8	0
Ramadhani Manyasi	5	0
Maria Sebaha	2	0

Appendix 4- Dakawa Survey (conducted at part of unpublished University of Sussex study)

Question	Percentage N=115
Gender of the Respondents	40-Female 60-Male
Household position of Respondent	51- Household Head 44- Spouse 4- Children 1- Other
Gender of household head	13- Female 87-Male
Age of household head	Average- 40.5 Range 22-82
Highest level of educational attainment	8- None 63-Primary 16-Secondary 3-Tertiary
How many people in the household	Av- 2.7 Adults Av-1.5 Children (range from 1-8 in total household)
How many adults are working?	Av-2.17 per household
Have you always lived in this village?	23-Yes 77-No
If not, when do you come here?	Mostly arrived during 2000s (1 in 1980s, several in 1990s) Range from 1966-2012
What types of food do you consume?	100- Rice/Ugali- no change in consumption over the year
What other economic activities contribute to your household?	49- have other economic activities 35- Business/trade 9-Livestock keeping 5-Employment
How much land do you use?	Av- 5.76 acres (range 1-26 acres) Av- 2.2 acres dry land Av-3.5 acres irrigated land
What is the nature of the landholding?	Irrigated land- all members of rice farm Dry land- 26 leasehold, 17 freehold, 0.5 sharecropping
What fertiliser do you use?	17- chemicals in dry land 1-manure in dry land 4- mixed in dry land 78- None in dry land 59-chemicals in wetland 2-manure in wetland

	13- mix in wetland 25- None in wetland
What crops do you grow?	16 rice in dry land 47 maize in dry land 2 beans in dry land 2 leafy veg in dry land 1 tomatoes in dry land 9 others in dry land 1 beans in wetland 2 maize in wetland 78 rice in wetland 3 leafy veg in wetland 3 tomatoes in wetland 3 others in wetland
If you grow maize- what varieties do you grow on which land?	46- do not grow maize 37- use hybrid maize 12- local 4- Mixed
Are there any crops that you started growing in the last five years?	Yes- 18 No- 82
Do you irrigate some of your crops?	Yes- 96 No-4
What is the source of the irrigation water?	River- 98 Dam- 1 Other- 1
Has water availability changed?	Strongly Agree- 33 Somewhat- 19 Disagree-29
What do you think is the cause?	12 climate change 2 Drought 8-destruction of water sources 7- deforestation 13- shortage of rainfall
Farming Practice- incidence	Conservation tillage-67 Legume incorporation-30 Water Harvesting-29 Crop Rotation-10 Use of compost/Manure-21 Infiltration Pits-2
Where did you learn this from?	65 learnt from neighbours 4 from Lead Farmer 16 Extension workers 30 NGO 61- strongly agreed

Did it have a positive effect?	30-somewhat agree 2 disagree 0 strongly disagree
Have you used advice through	Radio-30 Television- 3 SMS- 31
Do you own any of these devices	Radio-93 Television- 24 Mobile Phone- 91
Did you use the seasonal forecast in the last farming season?	Yes-38 No-62
If yes-	Local/traditional-10 Metereological-17 Both-8
Does your household provide agricultural casual labour within or beyond this village?	Yes-40 No-60
Are there any farming practices that you have learned through providing casual labour?	87% of those who provided casual labour learnt new farming practices