“Hot tomatoes”

Smallholder business strategies, market opportunities and irrigation system dynamics in Messica, Central Mozambique

M.Sc. Thesis by Berry van den Pol

June 2012

Irrigation and Water Engineering Group

WAGENINGEN UNIVERSITY
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Front page: Pictures of farmers characterising the five different business strategies practiced by smallholder irrigators in the research area. From left to right: a marginal farmer, an innovator, a land renting tomato producer, an intensive tomato producer and a diversified farmer.

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Master thesis Irrigation and Water Engineering submitted in partial fulfillment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

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Abstract

After a continuous plight of wars, labour exploitation and a lack of political support in the 20th century, smallholder farmers in the communities of Chirodzo and Ruaca have engaged in a fascinating recursive market and farming development in the last decade. Farmers have expanded and intensified their former subsistence production systems and now practice a commercialised way of farming. The area has developed into a hot spot for quality tomato production, where local and urban traders buy at the farm-gates. This research makes use of business strategies as a concept to explain the mechanisms that have driven different responses of farmers to this development. Next to that, a tomato value chain analysis identified the exact market opportunities farmers face.

Based on multiple-visit semi-structured interviews with 20 case study farmers, I could identify five different business strategies with an essentially different organisation of production and marketing. I found that the differentiation is driven by differing logics and capacities with respect to investment, risk management and innovation. Though suggested by several findings elsewhere in Mozambique, differences in the organisation of labour have not been a major differentiating factor. As water is the essential resource for horticultural production, I also looked into the effects of the established business strategies on the functioning of the furrow irrigation systems. It appeared that water was relatively abundant in the area. Irrigation system dynamics were mainly determined by the business strategies of the involved farmers, and that of the owner of the canal in particular. This contrasts sharply with findings from nearby more water-scarce areas where farmers actively tried to exert control over water management.

I have concluded the research by proposing the use of business strategies instead of the sustainable livelihoods framework. Next to that, I view the case of Chirodzo and Ruaca as evidence to promote a development model based on supporting farmer induced market development as an alternative to the currently promoted outgrower systems. Hence, with this research I want to contribute to a recognition of farmers' own agency in both scientific and development discourses.

Acknowledgements

I owe incredible thanks to the people who have supported me during the different phases of this research.

First, I would like to thank Gert Jan Veldwisch for his help to jointly shape a research within the field and location of my interest. I appreciate his efforts to read my work in detail, and his valuable comments and ideas have continuously stimulated me to further improve this research. I also want to thank Alex Bolding for his comments, whose different perspective on the matter has been a useful addition in the last phase of the research.

Furthermore I am very grateful for the support of Wouter Beekman during the preparation and execution of my fieldwork in Mozambique. It was a pleasure to informally discuss upon my research and to join him at the various social events in the weekends. Moreover I was very happy with the fact that he had arranged a translator, motorbike and living space near the research area, which have been optimal conditions for effective fieldwork.

I would also like to express my thanks to my translator and daily research buddy David Muchena. As a local farmer from the research area he has provided me with access to the interviewed farmers and with information on anything I wondered about. It was very pleasant to work with him and to discuss strategies to obtain particular information.

Even so, I wish to thank Rodrigues Piloto, who translated for me during the interviews in Chimoio, and carried out daily price monitoring for a couple of weeks. His honesty and care at any moment was very important to me, and I very much appreciated his accompany both in times of research and leisure.

Finally, I would like to thank everybody from Caritas-Messica for giving me a home during the fieldwork and for their patience with respect to our communication.

Content

1. Introduction

Smallholder farmers in Central Mozambique have been in a continuous plight of labour exploitation and wars during the 20th century. In the last decade however, the communities of Chirodzo and Ruaca have been developed into a main centre for commercialised tomato production for local and urban markets. Responding to market opportunities, farmers have expanded and increased their production systems considerably, without any external support. Considering the focus on market based development as the currently mainstream international development discourse, it is important to understand the conditions and mechanisms that have allowed such a fascinating development to take place in Chirodzo and Ruaca.

This research will use business strategies as a concept to explain the mechanisms driving farmers' responses to market opportunities. In doing so, I have tried to open the 'black box' within the sustainable livelihoods framework, which explains differentiation of livelihood outcomes by pointing at farmers' access to different assets but does not explain the actual factors that drive its use. This research does provide insights in those processes, by describing the role of farmers' individual capacities and logic. Next to the effects of the smallholder commercialisation process on socio-economic differentiation and poverty alleviation, I also used business strategies to explain the impact on the functioning of the different irrigation furrows.

Though several studies on farmer-managed irrigation systems in Mozambique (Bolding et al. 2009; Nkoka et al. 2011) have characterised water as a scarce resource that farmers need to control, observations from the research area rather suggest a relatively water abundant context. In this research I will explain that this accounts for very particular irrigation system dynamics, which forms an addition to the available literature on farmer managed irrigation systems in more water-scarce areas in Mozambique. By researching the particular dynamics in such a setting I will add information on a water abundant case to the knowledge of water distribution patterns in more water scarce farmer-managed irrigation systems.

This research combines a farmer-centred business strategy approach with a market chain perspective in order to identify market opportunities farmers use and the structural conditions that have allowed for this. The core of the research consists of a typology of farmers' business strategies, based on the logic that links farmers' production and marketing activities. The main part of the research has been executed through a combination of repeated observations and semi-structured interviews with 20 case study households. Next to this I executed semi-structured interviews with 40 traders and price monitoring and brief structured interviews with another 60 traders.

I start by explaining the research background and framework, research questions and the methodology that have shaped this research in chapter 2. Next, in chapter 3 I present a tomato value chain analysis and show the market opportunities that farmers do and do not make use of. In chapter 4 I elaborate the typology of business strategies, followed by an explanation on the underlying factors of strategy differentiation in chapter 5. Subsequently, in chapter 6 I discuss the impact of different strategies on the dynamics around water distribution and maintenance in the researched irrigation systems. In chapter 7 I present the contributions of this research to scientific thinking about smallholder farmers and evidence from Chirodzo and Ruaca to support an alternative model of pro-poor development. Finally, I use chapter 8 to reflect on the research methodology.

2. Research background and methodology

In this chapter I will frame the societal and conceptual background of this research and present the subsequent research questions and methodology that have evolved from that. I will first discuss the continuous plight of smallholder farmers in Central Mozambique and the lack of any support from governments and NGOs from colonial times up to the current situation of a predominantly neoliberal development discourse. Following, I will explain the main features of the research area and point out the fascinating agricultural and market development that has taken place in the last decade. After explaining my personal commitment for this research, I will raise the problem that it is unknown by what mechanisms the agricultural development in the research area has taken place. I will introduce the concept of business strategies to research how farmers have responded to the developments and what it has meant in terms of differentiation, pro-poor development and irrigation system dynamics. Following, I will describe the way I made use of different concepts and present the research questions. Finally, I will explain the motivation for my research design and methodology, which predominantly consists of semi-structured interviews with case study households.

2.1 Smallholder farming development in Central Mozambique

In this paragraph I will show how smallholder farmers in Central Mozambique have been continuously affected by a succession of wars and constraining policies in the last century. It is only recently that policies have been established to promote smallholder development. The international discourse focusing on green revolution and market development currently promote outgrower systems as the main pathway for rural development.

The plight of smallholder farmers throughout the 20th century

As an area of extensive gold trading that was controlled by local chiefs, the Manica district has been relatively wealthy compared to other districts in Central Mozambique for ages (Newitt, 1995). After a long-lasting period as part of the Gaza kingdom, Central Mozambique was colonised by the Portuguese and became subject to the company rule of Companhia de Moçambique in 1880. Rather than developing the region, this British owned company rule exploited African labour to create a monopoly in commodities like cotton and sugar (ibid). After the cessation of Companhia de Moçambique in 1942 the colonial authorities established a system of forced cotton production run through state monopolies (Newitt, 1995). The lack of resources, labour and fair market opportunities for peasant agriculture persisted (Kofi 1981; Kruks and Wisner 1984). Many young men left for Zimbabwe in this period, a process that continued in the wars that followed (Tornimbeni, 2005).

After the independence war that started in the 1960s and finished with the Carnation Coupe d'Etat in Lisbon in 1974, FRELIMO[1] took over the power in 1975. At the time malnutrition and disease were widespread, since subsistence agriculture had been totally distorted by the colonial policies and the departure of the Portuguese had led to a collapse of the commercial infrastructure (Kruks and Wisner, 1984). Forced labour on collectivised production systems and abandoned estates that were turned into State farms left no room for independent peasant farming. On top of that, in the late 1970s the civil war between followers of FRELIMO and RENAMO[2] started in the Manica district, and spread across the country in the 1980s until peace was finally signed for in 1992[3].

[1] Liberation Front of Mozambique (FRELIMO): the liberation movement that fought for the independence of Mozambique. It ruled the country from 1975 until the present, first as a single party and since 1992 as part of a multi-party parliament (Kruks and Wisner, 1984).

[2] National Resistance of Mozambique (RENAMO): an anti-communist political organisation founded in 1975.

[3] The civil war was driven by both national and international motives. Internationally it concerned a proxy for the Cold War in which South Africa and Rhodesia, with support from the USA, fought the perceived communist regime of FRELIMO. At the same time FRELIMO supported the fight against Apartheid in South Africa. Nationally, the war was a struggle between FRELIMO establishing a socialist collectivisation model and the replacement of traditional authorities with party structures, and RENAMO promoting the emulation of traditional Shona rules, the establishment of independent family peasantry and the division of Mozambique in three different states with its own indigenous identities (personal communication with Bolding; June 2012).

Manica was one of the most contested provinces and faced enormous human suffering, a further decline in agricultural production and extensive migration[4] (Silva 2007; Alexander 1997).
In 1983, the budgetary dependence of Mozambique on the IMF, World Bank and bilateral donors forced FRELIMO to introduce more market oriented policies. The neo-liberal discourse in those organisations originates from Rostow's (1960) theory, which states that economic growth is the essential driver of a state's gradual transformation into a fully modernised society based on industry and services. Johnston and Mellor (1961) made an important contribution by emphasising the urge of agricultural modernisation for establishing sufficient food supply and resulting demand for industrial products by the farm population. The range of market based reforms that were implemented in 1983 also allowed peasants to produce for themselves, though they were still obliged to market to State marketing boards[5]. Irrigated estates were re-privatised and a green revolution strategy was launched to stimulate the use of modern agricultural technology. Though the green revolution descends from the idea of Schultz (1964) that peasant farmers should be provided with such technology, the subsequent policies merely focused on projects for large-scale agricultural production (Mawere, 2010).

It was only recently that a first recognition and development plan emerged with respect to farmer managed irrigation systems. Together with the World Bank, the National Directorate for Agrarian Services (DNSA) developed the PROIRRI programme to promote smallholder irrigation development by providing technical advice and better market links (MIPP, 2011). This strategy is one of the two agricultural development models currently promoted by the Mozambican state; the second focuses on establishing private estates with smallholder outgrowers surrounding them[6].

Market links as the current answer for smallholder development

The mainstream international development discourse spread by the World Bank currently focuses on linking smallholder farmers to markets and the private sector (World Bank and DFID, 2005). Driven by the neoliberal and green revolution discourses discussed above, outgrower systems are promoted in which private companies provide the inputs and technology that smallholder farmers lack. Farmers need to move towards commercialisation, which implies a market oriented approach, marketable surplus production and greater specialisation. As an alternative to outgrower systems, Ferris et al. (2006) rather recommend smallholders to identify and engage in pluri-actor markets, avoiding farmers' dependence on one company. However, both approaches share the positive view on market development, as "many development specialists agree that sustainable livelihoods can only be achieved through competitive market engagement" (ibid, p. 30).

Both approaches recognise the comparative advantages of smallholder farmers over larger farms with respect to transaction costs in accessing family labour and intensive local knowledge, as described by several authors (Lipton 2005; IFAD 2001; Kydd and Poulton 2000). However, Poulton et al. (2005) explain that disagreement exists on whether assisting services can effectively stimulate small-scale agriculture to make up for its high unit transaction costs in accessing capital, market and technical information and input and output markets, which Maxwell (2004) had put forward. While advocates of outgrower systems indicate that private companies would be more efficient in providing such services, Ferris et al. (2006) argue that farmers could also be supported to innovate and create effective agro enterprises themselves. Nevertheless, some authors also criticise the currently increasing support for market-driven development in whatever form, like Sanginga et al. (2004) who argues that market oriented production increases social differentiation, since the poorest farmers are usually unable to benefit from such development.

[4] At the time, the research area belonged to the so-called 'Beira corridor', which was an area around the railway controlled by the Zimbabwean army to secure their access to the port of Beira. Many internally displaced people and refugees came to this area, increasing the pressure on the natural resource base. After the war, a considerable part of them stayed in the area (Bolding, 2007). The village of Messica did not exist before the war and is a product of this displacement of rural populations now located between the main road and the railway (personal communication with Beekman; August 2011).
[5] Personal communication with Bolding, June 2012.
[6] Personal communication with Bolding, June 2012.

In short, in the past century smallholder farmers in Central Mozambique have experienced tremendous misery due to continuous periods of wars and labour exploitation. Until recently, there had been no supporting policies for smallholder farmers and farmer managed irrigation systems. The currently mainstream international development discourses emphasise the urge to link smallholder farmers to markets. Whether farmers will be able to engage in pluri-actor market chains themselves or if this should rather be achieved through outgrower systems is still debated.

2.2 The research area; a hot spot of commercial smallholder agriculture

Despite the general plight of smallholder farmers and the lack of external support, widespread commercially-oriented smallholder production systems have developed in the communities of Chirodzo and Ruaca during the last decade. The present market linkages and potential for further irrigation development were the main arguments to localise the Messica Irrigation Pilot Project (MIPP) in this area. Since my research informs the MIPP project, I also focused my analysis on those two villages. The goal and activities of the MIPP project are explained in box 1.

Box 1: The Messica Irrigation Pilot Project (MIPP)

The MIPP project has been created as a response to the fact that many large-scale irrigation programs are expensive and do not create sustainability beyond the project period. On the contrary, most sustainable irrigation developments have been established without intervention from external parties (MIPP, 2011). According to MIPP (2011), the most important problem of current large-scale irrigation interventions is the predefined character of the intervention that is obligatory under current tender procedures. This approach does not offer the opportunity to consult the target group. After the tender is won the agency is forced to implement the program exactly as established in the proposal, even though the need for adaptation may arise with later insights from the field (ibid). Projects that integrate the possibilities and ambitions of the communities in the design of the intervention usually depend on long-term involvement and integration into other development programs, which makes such approaches difficult to upscale (ibid).

In response to this problem, a Dutch consortium[1] in collaboration with two Mozambican organisations[1] is planning to implement the 'Messica Irrigation Pilot Project' (MIPP). This project aims "to demonstrate that it is possible to cheaply develop, monitor and evaluate sustainable and pro-poor irrigation at a large scale through an integrated participatory approach" (MIPP 2011, p. 4). The integrated character of the project will be realised by building on existing practices, explicitly discussing changes in resource distribution at community level, jointly operating with organisations that have access to different knowledge and skills, and facilitating an innovation process for interactive learning. The project hopes to provide evidence for an innovative solution to the constraints caused by current tender procedures, by creating the possibility "to apply a participatory approach while at the same time creating clear benchmarks that allow for transparent monitoring and evaluation" (ibid, p. 5).

The MIPP project consists of a pilot project, in which the approach will be implemented and used as a show-case, and of a capacity strengthening sub-project. The results of the project may

Localisation

The communities of Chirodzo and Ruaca are located near the village of Messica in the Manica district, which belongs to the province of Manica in Central Mozambique. The village of Messica counts about 14,000

inhabitants (Brinkhoff, 2010) and is situated along one of the main roads of the country (EN 6), which connects Harare to Beira. This road also connects Messica with the cities Chimoio (50 km) and Manica (25 km). The communities are situated at the western side of a mountain range that runs in North-South direction (see figure 1). Several streams flow down the western side of this mountain range, from North to South respectively the rivers Nhamahuare, Ruaca, Nhamazoma, Godi, Chirodzo, Nhamaguere, Nhamazoma2 and Nhamanuchi. The rivers had been mapped during the initial phase of the MIPP project by Reumkens and de Boer (2011), two other students from Wageningen University. However, it should be noted that going northwards and around the mountain range there are more rivers, which are also in use but have not been mapped yet.

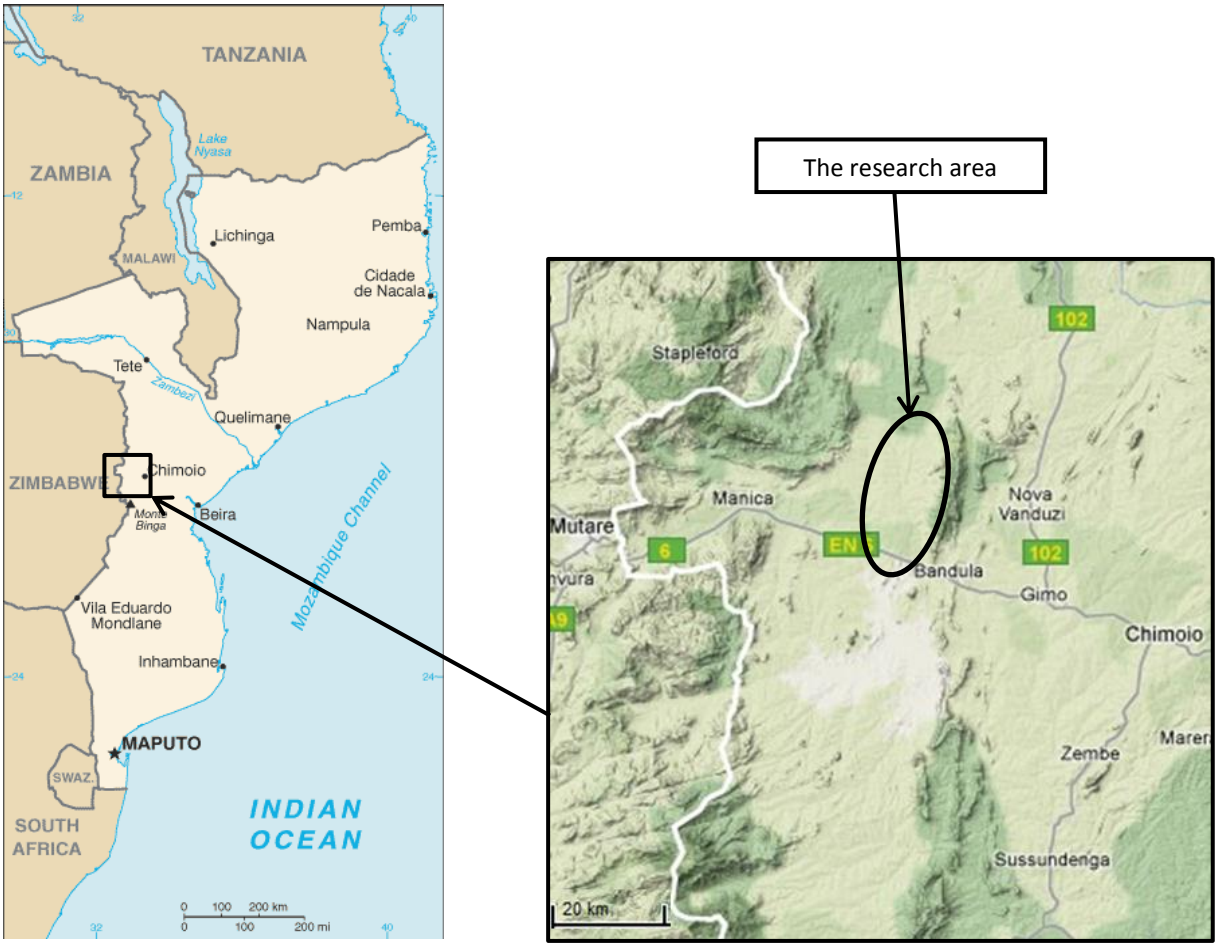

Figure 1 Location of the research area within Mozambique

The population in the central part of the Manica province mainly belongs to the Manyika tribe, which is a sub-group of the Shona ethnicity. The links with the Shona in Zimbabwe, especially in the form of labour migration, kin relations and cross-border chieftaincies have had important implications for agriculture in the area. Bannerman (1998) explains that both the history of gold mining and the border-crossing knowledge and input markets from relatively prosperous Zimbabwe account for the fact that smallholder farming systems in the Manica district have always been more advanced than elsewhere in Mozambique. In a case study carried out in the border area, Schippers (2008) found that migratory farmers are very innovative, which supported the enterprising attitude within the community and the application of relatively advanced farming techniques. The migratory farmers are often former Mozambican labour migrants who returned from Zimbabwe to look for new livelihood sources after the commercial farm invasions starting in 2000 and the subsequent collapse of the economy and Zimbabwe's currency (Bolding et al. 2009; Bolding 2012). The fact that the village of Messica is actually inhabited by a melting pot of refugees from various parts of Mozambique also adds to the fact that farmers in Chirodzo and Ruaca are characterised by a diverse range of farming experiences.

Farmer managed irrigation systems

Irrigation is widely practised in the Manica district and some systems date back to the beginning of the 20th century (Beekman 2011; Bolding et al. 2009). Most schemes have emerged without any government interference (Bolding et al., 2009) and official inventories have missed out the majority of the schemes (Beekman, 2011). A more detailed inventory done by Beekman (2011) identified 63 hubs of farmer managed irrigation systems in the Manica district, and recently about 64 systems have been identified in the Messica research area alone (Reumkens and de Boer, 2011). The smallholder irrigation sector is mainly characterised by gravity irrigation with furrows. Farmers divert water from small permanent streams[7] that flow down the mountain through temporary diversions made of stones, branches, grass or bags of sand (MIPP, 2011). The water is distributed through small earthen furrows towards the bench terraces and fields. The streams and furrows seem to form a hydrologically connected network as referred to by Ambler (1991), which implies that leakages from one source can be recaptured by another source or furrow downstream.

Typically, a scheme consists of one main furrow with several off-takes, together serving an area ranging from about 0.5 to 5 hectares. The membership varies from 1 to 15 users per scheme. The principles of water rights are rooted in local custom and everybody including newcomers, has a right to water and can dig his/her own furrow, as long as the whole flow of a stream is not diverted. In order to keep the water right, users should participate in the annual maintenance. However, there is a strong incentive to give everybody a chance to get water, partly because of the fear of jealousy and subsequent witchcraft accusations (Schippers, 2008). In the schemes researched by Bolding et al. (2009) members from one furrow often irrigated by rotation, but the actual mode of organisation varies considerably among different furrows.

The development of commercial smallholder horticultural production

Traditionally, agriculture by smallholder farmers in Chirodzo and Ruaca is characterised by irrigated production of cabbage, tomatoes and other vegetables on relatively plain irrigable fields, rain-fed maize production covering the major part of the research area and in some cases additional fruit, yam or cassava production on the stream banks. Maize is grown in the rainy season from November till May, predominantly on fields that cannot be irrigated[8]. The production of horticultural crops generally takes place from May till October[9]. Beekman (2011) explained that the relatively high rainfall makes it a very suitable area for horticultural production. Small-scale agriculture is practised manually, although most farmers use draught traction to prepare their fields.

Though most farmers used to produce mainly for subsistence, in the last decade the area has developed into a main centre of quality tomato production for urban markets. Many farmers have considerably expanded their irrigated area and intensified their production by using purchased seeds, fertiliser and pesticides. Traders come from far away to buy tomatoes from farmers in the area. Though about half of the farmers in the area are a member of the local farmers' union, the establishment of which has been supported by the NGOs Caritas and MICAIA[10], its role in this development seems minimal[11]. The extension services that were offered to local residents a few years before the period of fieldwork neither explain the development of expansion, intensification and marketing, as those concerned predominantly methods for organic farming[12]. Rather, in one

[7] Overall streams are permanent, although two farmers have indicated that some sub streams can fall dry a few hours a day during the hottest months. I did not encounter any situation in which water did no longer reach the tail end of the irrigation furrows when I was in the area from September to November (the end of the hot season), however some farmers had indicated that rainfall was above average in that year.

[8] The maize that has been planted on irrigable fields is only irrigated when there is a lack of rain.

[9] In chapter 4 I will show though that this varies considerably per farmer.

[10] Two Mozambican non-profit organisations, both part of larger international networks. View http://www.caritas.org/ and http://www.micaia.org/ respectively.

[11] Except for the structural meetings, the associations do not provide any supporting services to facilitate joint input purchasing or output marketing.

[12] Nowadays the supporting projects have all ceased operating as the project terms had been reached. The NGOs have moved their activities to areas with less developed production systems.

decade farmers seem to have developed the area and their production systems from subsistence to commercial production without any external support.

Hence, after a century of war and labour exploitation farmers have re-migrated into the areas of Chirodzo and Ruaca. Despite the absence of support for farmer-managed irrigation systems, farmers have restarted their furrow irrigation tradition and started producing food for their own consumption. In the last decade, most irrigating farmers have realised a major expansion and intensification of their irrigated production, and the area has become a hot spot for quality tomato production for local and urban markets. The extraordinary development has been achieved practically without any external support.

Personal commitment

As a student in International land and water management at Wageningen University I have gained an interest in improving small-scale farmers' livelihoods and the role that water can play in this. I found the courses that took the broader scope and viewed water management as a key aspect of rural development the most interesting. Driven by this, I followed a half-year program on rural development at Montpellier SupAgro. This program made me aware of the essential role that smallholder agriculture plays in establishing food security and social stability. Next to this I gained insights and interest in the overall functioning of farming systems. At the same time, the book 'Dead aid' from Moyo (2010), made me think about the contribution that private investments can have in development, as opposed to financial aid to governments. As a result I got interested in so-called impact investment and outgrower systems, since companies and large scale projects have the financial means to create a supporting environment that could enable smallholder farmers to increase their production themselves. I find the fact that in Chirodzo and Ruaca farmers themselves are responsible for the whole marketing process even more interesting and sustainable than outgrower systems, since the farmers are not dependent on one single actor. I considered such a dynamic and multi-actor setting as the ideal opportunity to learn about rural markets and its impact on smallholder farmers' production strategies and opportunities.

2.3 Problem statement

Considering the continuous plight and lack of political support for smallholder farmers in Central Mozambique during the last century, the recent booming development of commercialised smallholder agriculture in Chirodzo and Ruaca is fascinating. Farmers have tremendously expanded and intensified their production systems, and the area is now known for its quality tomato production for local and urban markets.

So far, it is unknown what mechanisms have driven these developments. Regarding the current promotion of market based development by international funding institutions, it is important to reveal the conditions that have allowed such development to take place in Chirodzo and Ruaca. Next to that, in order to verify whether the development has actually enhanced pro-poor development, an understanding should be established about the effects on socio-economic differentiation that some authors have warned for. Moreover, considering the strict dependence of horticultural production on irrigation, it is important to assess how the described development affects the functioning of different irrigation furrows.

In order to reveal these issues, I looked into the business strategies of irrigating farmers, as depicted in figure 2. The business strategies should explain how farmers have dealt with the market opportunities in different ways and how such strategies have influenced the dynamics in irrigation systems. By researching the recursive nature of these processes as indicated by the small arrows, I also gained an understanding of the roles of the markets and irrigation systems in farmers' development.

Hence, in order to understand the mechanisms and conditions that have driven smallholder development in Chirodzo and Ruaca, I looked at the recursive nature of farmers' business strategies and respectively market opportunities and irrigation system dynamics.

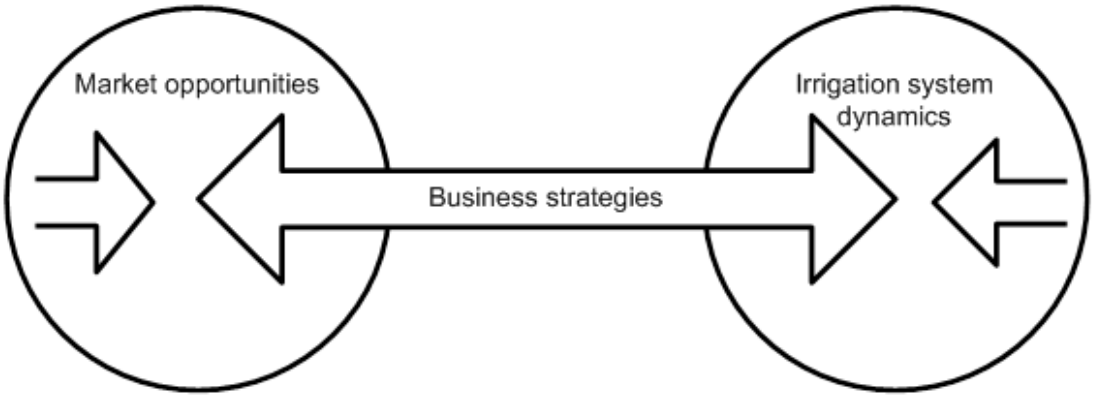

Figure 2 The recursive nature of business strategies and respectively market opportunities and irrigation system dynamics that forms the scope of this research

2.4 Research objectives

Societal relevance

Since the currently mainstream development discourse focuses on market oriented development, I would like to contribute to a better understanding of the essential conditions that allow for such development by learning from the experiences of farmers in Chirodzo and Ruaca. Explaining the various drivers of that development should provide evidence for debates around the various neoliberal development models. This is, an increased production caused by a response of farmers to new market links would support the neoliberal development discourse and the advocates of farmers' engagement in pluri-actor markets in particular. Moreover, an assessment of the factors that underlie differentiated responses from farmers, could inform interventions aiming at pro-poor market development so that such factors could be targeted specifically.

Finally, this research should also inform the inception phase of the MIPP irrigation project. By looking at the role of irrigation system dynamics in farmers' business strategies, this research provides insight into the extent to which investments in irrigation infrastructure will contribute to pro-poor development in the area, and not be limited to support the wealthier farmers who have the means to realise a corresponding growth in the other aspects of their business strategy as well.

Scientific objectives

The main academic objective of this research is to provide insights in the mechanisms that explain how farmers strategically organise their businesses. In chapter 2.5 I will explain that the sustainable livelihoods framework suggests a direct relation between farmers' assets and their livelihood outcomes. In this research I used business strategies as a concept to explain what happens in this 'black box' that links farmers' assets and livelihoods outcomes. The research should create an understanding about the role of underlying factors that drive decisions of individual farmers to use a combination of their assets to realise a particular outcome or not. Hence, I want to contribute to a research perspective that recognises farmers own agency rather than viewing their livelihoods as a direct outcome of their assets and environment.

A second scientific objective concerns an addition I would like to make to the literature on farmer-managed irrigation systems in Eastern Mozambique. Since contrary to other cases in the region researched by the IWE group[13] water is relatively abundant in Chirodzo and Ruaca, I will assess whether this accounts for a different functioning of the irrigation systems.

Personal objectives

With this research I hoped to learn more about business strategies of smallholder farmers and their perspectives on market engagement. Since I would like to work with smallholder farmers in the future, I

[13] Bolding et al. (2009); Nkoka et al. (2011); more information follows in chapter 2.5.

consider it essential to have an understanding about the logics behind smallholder farming systems and the main difficulties they face. Next to this I have been interested in how external interventions can create a more supporting environment for smallholder farmers. By contributing to the MIPP project I hoped to learn more about the functioning of such projects, and the opportunities it offers to really make a change.

Furthermore, I have used this research to learn how to plan and carry out a research on my own. I gained more experience in interviewing in particular, and in using the data to draw conclusions in a scientifically responsible way. Next to this, it was a valuable experience to live for three months in a Mozambican village and realise that essentially we do not differ much.

2.5 Concepts and theories

The core of this research concerns the ways in which farmers organise their production to shape and use market opportunities in the area. I will refer to this as a farmer's 'business strategy', which comprises the consistent logic of his/her production and marketing activities. My view on the logic of such strategies corresponds to the 'farming styles' concept described by Van der Ploeg et al. (2009), which I will use as a framework to analyse the different strategies. Subsequently, after identifying different business strategies I will use the sustainable livelihoods framework to look for the underlying factors of strategy differentiation. Before identifying different business strategies however, I will use pro-poor market approaches and a value chain analysis in particular to assess the market opportunities that farmers in the research area could actually make use of. Finally, I will use concepts discussing the dynamics of water use in farmer-managed irrigation systems to explain the impact of different business strategies on that. In figure 3 I depicted the objects I will analyse by the different concepts mentioned. As constructing a new framework that includes the four approaches is beyond the scope of this research and my capabilities, and even experts (Albu, 2008) question the manageability of such a framework[14], I will rather use the approaches next to each other to deepen the various aspects related to farmers' business strategies. I will now explain into more detail how I used each of those concepts in my research.

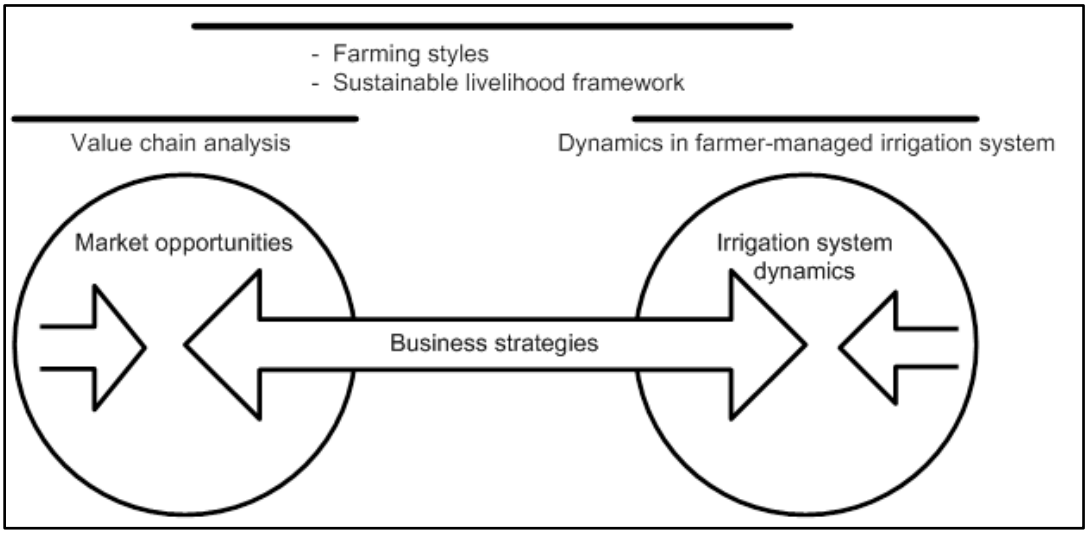

Figure 3 The research framework

In the lower part of the figure the main research objects are depicted and in the upper part the frameworks that I will use for analysing the particular objects. I will use the farmer-centred farming styles and sustainable livelihoods framework to analyse respectively farmers' business strategies and the underlying reasons for its differentiation. Furthermore I use the market-focused M4P approaches and concepts on irrigation system dynamics to deepen the links between those aspects and farmers' business strategies.

[14] Albu (2008) argues that market approaches and the sustainable livelihoods framework cannot be merged together as this will diminish the functional rationale of a framework to reduce complexity to manageable dimensions.

Pro-poor market approaches to explore market opportunities

Making Markets Work for the Poor (M4P) approaches have emerged in the last decade and are promoted increasingly for development interventions and as a tool for rural analyses (Ruijter de Wildt et al., 2006). It has emerged as a response to interventions that failed to generate sustainable outcomes, mostly as a consequence of a lack of understanding about market systems (ibid). M4P approaches emphasise the importance of markets for the poor, and consider a sound understanding of market systems as the necessary basis for all interventions (Albu, 2008). Next to a framework for understanding these market systems, it also forms an important rationale for thinking about poverty reduction and guidance for interventions (Ruijter de Wildt et al., 2006).

Basically, the M4P approach aims to understand the relation between people's poverty and capacities and opportunities to do something about it (Albu, 2008). Poverty is considered to be a result of 'systematic constraints' in the structures and processes of people's environment, and of failings of market institutions and arrangements to include the poor in particular (ibid). M4P approaches recognise that markets are subject to a complex range of structures and institutional arrangements that are unique for each situation (Ruijter de Wildt et al., 2006). In order to understand this relation, M4P provides a framework for analysis to gain insights into the dynamics of a market system (ibid).

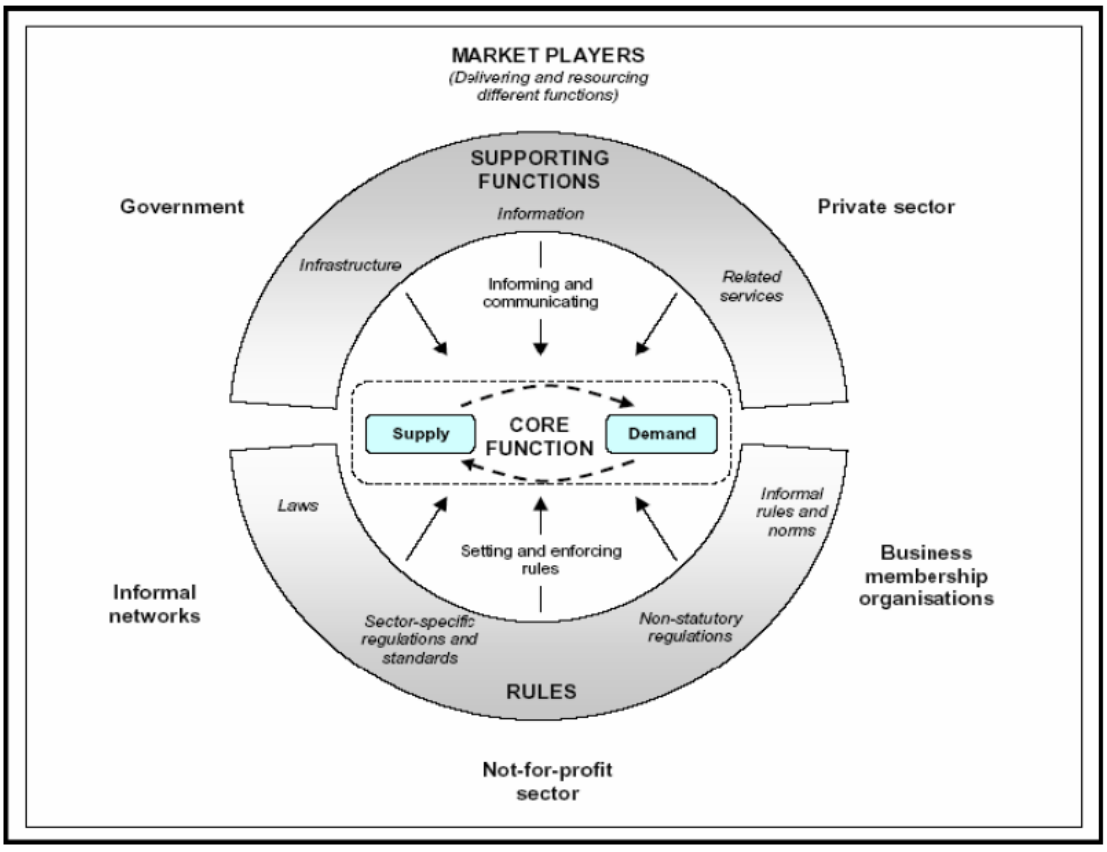

Figure 4 A market system map as used by Ruijter de Wildt et al. (2006)

The visual representation of the M4P framework is not yet highly established, although a growing consensus is emerging about its principle components (Albu, 2008). Figure 4 shows the framework as used by Ruijter de Wildt et al. (2006). The core of the framework consists of transactions that take place when supply and demand meet. This transaction can represent one simple exchange, but also a sequence of interrelated transactions that occur when a product moves along a value-chain (Albu, 2008). The framework shows that markets do not merely function as a consequence of supply and demand, but that rules and supporting functions determine their behaviour, practices and relations (Ruijter de Wildt et al., 2006). Rules include formal and informal rules and other standards and codes of practice. Supporting functions cover a range of aspects including

infrastructure, information, co-ordination and other services (ibid), and can be characterised as services that support business development and enable an efficient marketing process (Ostertag et al., 2007). Furthermore, the framework explicitly shows the diverse range of formal and informal players that can be active within or outside the core transactions. To understand the market system it is essential to consider the inter-relation and roles of all elements that are at play (ibid).

M4P approaches emphasise that market opportunities only arise when there is a certain demand for outputs that can be produced with a particular set of assets (Albu, 2008). Analysing this demand is at the core of M4P approaches and some authors even propose to put demand for livelihood outputs at the centre of any analysis that concerns farmers' livelihoods (Dorward and Poole, 2005). Though this is a useful approach for interventions that search for the identification of new markets, in this research I will put farmers' business strategies at the centre of analysis and only assess the actual market demand and opportunities that farmers make use of, rather than identify future opportunities. I will also look at the way farmers establish relations themselves and thereby benefit from other market opportunities than other farmers. Since the research area developed itself in the first place as a tomato-producing area and for nearly all farmers tomatoes are their most important cash crop, I focused the analysis on the tomato market. In this research I will not go into the historic reasons that explain the focus on tomato market development and the neglect of other crops by the urban wholesalers that buy in the area.

Market opportunities or output markets consist of actors that have a demand for a certain produce that farmers can offer by means of a transaction. In the next paragraph I explain that farmers interact with market actors by means of different marketing practices, which corresponds to different prices, volumes and conditions they face. In this way the marketing process is actually a social transaction that is based on the relation and marketing skills of the particular actors. Therefore, the research also looks at how the relationship between a farmer and his/her trader can be characterised. Particular market actors are featured by a specific location and by requirements regarding quality, quantity and timing. As a result, the output market one engages in will have implications for the organisation of production. An output market can be depicted as a market chain. Lundy et al. (2007) explain that "a market chain is used to describe the numerous links that connect all the actors and transactions involved in the movement of agricultural goods from the farm to the final consumer" (p. 12). Within the portfolio of M4P approaches, value-chain analyses are especially designed to create an understanding of output markets (Albu, 2008).

In most definitions, a value chain equals a market chain or supply chain, and describes the full range of activities required to bring a product from its conception through the different phases of production to its delivery to final consumers and beyond (Kaplinsky and Morris, 2001). All market actors that are part of the chain perform a number of value adding tasks ranging from producing to packaging and selling (Ferris et al., 2006). A main distinction can be made between retail sellers who sell directly to consumers, and wholesale traders who serve as an intermediary between producers and retailers (Pilat, 1997). Porter (1985) established the value chain analysis as a tool to identify the value of each step of production, in order to optimise the production process by which a company can improve its competitive advantage. M4P approaches have introduced the concept for smallholder farmers, for whom it can provide important information on buying conditions, opportunities, constraints, finance options and prospects for growth (Ferris et al., 2006). Vijfhuizen (2003) showed that simple economic analysis cannot always account for the value of crops from smallholder schemes and therefore this research also looks at the possible non-monetary value of farmers' production, e.g. when farmers use it for consumption or reciprocal gifts.

Hence, the value chain analysis has identified the actors engaged in the tomato market and their relations and agreements. The way individual farmers create their market opportunities is explained as part of their business strategies. The different markets have been characterised with respect to the price, quality and value adding activities carried out by the particular traders. I have assessed whether those features are predominantly supply-driven, i.e. induced by the particular supply at a given period, or demand-driven, i.e. caused by the

behaviour of customers or consumers. Moreover I analysed both the monetary and non-monetary value of tomatoes in different stages of the value chain. The rules and supporting functions have only been assessed with respect to its use by farmers in the research area.

Farming styles to identify different business strategies

While I used the value chain analysis mainly to explore the market as an external environment, I have used the farming styles concept to assess how farmers make use of that. Van der Ploeg et al. (2009) explain that farming styles appear as an internally consistent mode of farming practices. It creates a "specific productive constellation that is reflected in, and through, the specific characteristics of the objects of labour" (ibid, p. 126). The concept corresponds to the organisation of production, which Veldwisch and Spoor (2008) define as "the internal logic of organisation, i.e. the links between the organisation of inputs, land, management, labour and outputs" (p. 432). Different farming styles can be distinguished for a particular productive orientation and for similar structural characteristics (Van der Ploeg et al.; 2009). In this research, I identified different farming styles for smallholder irrigated production in the research area.

The identification of farming styles creates a recognition of the different social, economic and productive logics that exist among farmers. The approach avoids to create any hierarchy of the different farming styles and criticises the idea of one viable development pathway (ibid). It considers the differentiated development as an on-going process with unclear outcomes in contrast to approaches that predefine those, such as Dorward et al. (2009) who identified strategies of hanging in, stepping up and stepping out to refer to farmers who maintain, improve or shift their farming activities. The conceptualisation of different logics rather than different viability corresponds better to the differentiation of farming practices I observed in the research area.

Van der Ploeg et al. (2009) explain that the farming style approach recognises the fact that farmers exercise their own agency. A farming style implies a way of decision-making based on particular strategic notions (ibid). In order to stress that farmers' decisions result in the first place from their own strategic agency I refer to their 'business strategy' rather than their 'farming style' in this research. Moreover, I chose to use this term because by analysing farmers' marketing activities as well I will explicitly assess their strategies beyond the mere production system objects that are the usual scope of farming style analyses. However, I realise that in this way I neglect household considerations that are not based on market motives. Though the role of intra-household relations on farmers' business strategies have not been assessed in this research, I provide a picture of the overall livelihood portfolios of two farmers in order to illustrate the livelihoods in which the business strategies are embedded. I define a farmer's business strategy as a consistent combination of his/her activities that aims to realise a specific objective, e.g. the use of a particular market opportunity or food production for home-consumption. This corresponds to the definition of a livelihood strategy by DFID (2001), whose approach to analyse underlying factors of strategy differentiation I explain in the next paragraph. The business strategy is in my view a characterisation of the whole farm system and comprises the complete business model, which includes both production and marketing activities.

Production

According to Van der Ploeg et al. (2009) a farming style is reflected by the objects of labour, such as the crops, fields or inputs. Pingali (2001) based an analysis of the extent to which farming systems are commercialised on a production system's objectives, main input sources, product mix and household income sources. I consider those features as essential elements to assess the production objects of a business strategy, as it is through such a strategy that farmers have realised their extent of commercialisation. Hence, the internal logic of the production process consists of farming activities that are executed in order to realise a certain production objective.

Clearly, one farm often contains various production systems, each with its own objective. Such objectives can be of a financial character, e.g. growing cash crops to earn money, but also of a social character, e.g. producing groundnuts to be used as gifts, or of a cultural character, e.g. a man that should produce sufficient food for his

family. Woodhouse (2003) explained that it can also be an objective to provide household members in town with food. However, production systems with the same objective, e.g. to earn cash money, can still function according to different logics. Dependent on the available output markets, farmers can opt for different strategies to realise the objective. One can orient his/her production to markets with different requirements regarding quantity and quality, e.g. fresh or dried tomatoes, or tomatoes of a particular size or kind. The use of a particular output market is also shaped by the timing of the production, e.g. by serving traders that demand a constant supply, or by planning the harvests beyond the peak production periods. This linkage works in two directions; as farmers are able to change both their production or marketing practices.

The production objectives are reflected by a specific organisation of the production objects. Regarding the input source, the main issue of interest is to what extent the inputs are delivered by the household itself or rather purchased by means of financial investment. This accounts for a wide range of inputs. Labour power could be delivered by household members and animals only, but could also be mechanised or carried out by employees. Soil fertility could be maintained by farm yard manure, but also by chemical fertilisers and purchased feed for the animals (Pingali, 2001). Pests could be managed by household labour, but also by purchased insecticides, fungicides and herbicides.

Another indicator of a farmer's business strategy is the total product mix, which can vary from cultivating a wide range of products to a farm that is highly specialised in specific products or varieties (ibid). Linked to this, human nutrition can predominantly consist of home-produced food, but also of mainly purchased food. Household income sources could be limited to cash crop production, but may also include non-agricultural income.

Marketing

In a broad sense, marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods and services to create exchanges that satisfy individual and organisational goals (Kotler and Keller, 2009). However, as explained above by the M4P framework, the core of marketing consists of the transactions that take place between different actors. Market actors are the people who are directly involved in the exchange of goods in the value chain (Ostertag et al., 2007). All of them have different roles, capacities, influences and interests (Albu, 2008). The social links between the actors shape the marketing process (Ostertag et al., 2007). I view the marketing practices and business organisation in which farmers engage as a manifestation of those relations. Marketing practices in this respect refer to the product, price, placement and promotion activities that farmers employ in their exchanges, which correspond to its definition by Kotler and Keller (2009).

Farmers' business organisation refers to the degree of vertical integration or coordination and horizontal integration (Ferris et al., 2006). Vertical integration or coordination refers to the relation of two or more successive functions in the value chain, whereas horizontal integration implies the combination of management skills, enterprises or actors that perform similar functions (ibid). Lemeilleur and Codron (2011) explain that smallholder farmers can often choose for either individual vertical integration, in which they sell to identified buyers by individually negotiated agreements, or collective horizontal integration in which they market through associations, cooperatives or informal cooperation. Both vertical and horizontal integration can be organised by a variety of arrangements, reflecting the relation of the particular actors. Next to this, farmers make use of rules and supporting functions in different ways. Rules or norms with respect to the responsibility for particular tasks or the term of payment can be used by farmers as a reference for their individual trade agreements. The use of market information, credit, transport facilities or a mobile phone can be essential to draw upon in order to realise a particular business strategy.

Hence, an important part of the research on farmers' business strategies consists of assessing the particular objects of labour in both farmers' production and marketing activities. Nevertheless, like I explained above it

are especially the links between the described components that reflect the logic of a farmer's business strategy and the way he/she makes use of the available market opportunities in the area.

The sustainable livelihoods framework to explain the underlying factors of strategy differentiation

The sustainable livelihoods (SL) concept originates from WCED (1987) and was further developed by Chambers and Conway (1992). They defined a livelihood as "comprising the capabilities, assets and activities required for a means of living" (p. 6). Carney (1998) and Scoones (1998) adapted the concept, emphasising the notion that people construct livelihoods by drawing on a range of assets and entitlements. This concept has been further developed as a framework and a set of action principles (Farrington, 2001). The framework forms a tool to improve our understanding of the factors that lie behind people's choice of livelihood strategies (DFID, 2001). The analysis usually takes place on an individual or household level. Advocates of the framework consider a livelihood analysis as a prerequisite for any sound intervention (DFID 2001; Carney 1998). A commonly used and highly influential sustainable livelihoods framework has been established by DFID (2001) and is depicted in figure 5.

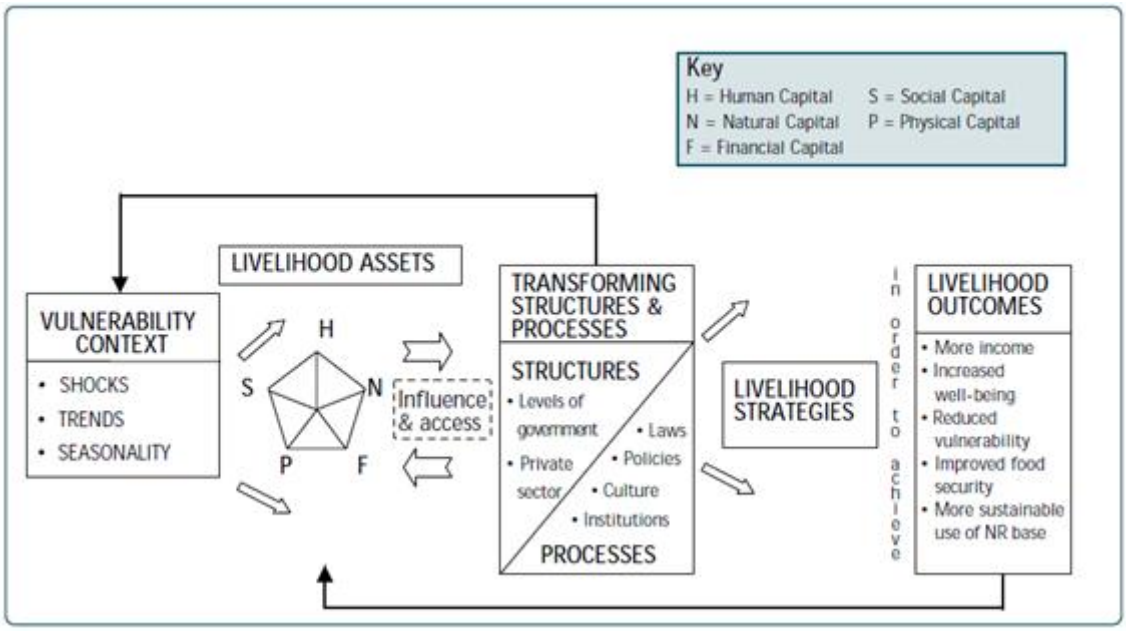

Figure 5 The sustainable livelihoods framework of DFID (2001)

In this framework, it is assumed that farmers realise their livelihood strategies by combining different types of capital assets. The fact that farmers have different access to those assets implies that different livelihood strategies can be employed (ibid). This framework identifies fives types of capital assets, i.e. human, social, natural, physical and financial, which are at the core of the analysis.[15] Subsequently, the SL framework states that farmers' assets are mediated by external transforming structures and processes. However, I have used the described M4P approaches to analyse those, rather than the SL framework[16]. This is, the focus of M4P

[15] Human capital represents skills, knowledge, ability to labour and good health. Social capital refers to the social resources upon which people can draw, which are usually established by networks, membership to groups and relationships of trust and exchange. Natural capital is used to describe the natural resource stocks from which resource flows and services are derived. Physical capital includes the basic infrastructure and producer goods, i.e. tools and equipment. Financial capital comprises the financial resources that people can use, which can be present in the forms of savings or inflows of money (DFID, 2001).

[16] A seminar hosted by the Centre for Development Studies at the University of Bath, UK, in July 2009, suggested that M4P approaches should be used in combination with the SL framework. (Owusu-Gyamfi 2009). Johnson (2009) explains that both SL and PPM approaches take a systems perspective and recognise that livelihood processes are affected by wider social, political, economic and environmental processes. Both are characterised by their emphasis on an accurate analysis of the specific case as a prerequisite for any intervention (Albu, 2008). However, the difference in focus between the two approaches makes them complementary, and some even warn for the danger of promoting the approaches in isolation

approaches on understanding market institutions "has unpacked the policies, institutions and processes box contained in the SL framework that often went unexamined" (Johnson 2009, p. 1). M4P approaches "have helped understanding of the links between market development and transforming lives, and the relationship between markets and the social, human, physical, natural and financial assets available to poor people" (Owusu-Gyamfi 2009, p. 2). Since markets as an institution form a crucial transforming process between people's assets and their livelihood outcomes, Owusu-Gyamfi (2009) argues that the M4P framework is actually situated alongside and within the SL framework.

Within the conditions shaped by structures and processes, people engage in a dynamic process in which they combine their assets in order to realise their needs or livelihood outcomes. The 'livelihood strategy' that constitutes such a negotiation of their livelihood outcomes, corresponds to my definition of a farmer's business strategy. There is a continuous interaction between people's different assets and between their assets and the structures and processes surrounding them. Furthermore, assets are affected by people's livelihood outcomes and by an external vulnerability context which lies beyond their own control (ibid).

The sustainable livelihood framework can be helpful to organise the many factors that influence the livelihood strategies that farmers use, as an analytical structure that represents a complex reality in a manageable form (DFID, 1999). However, some argue that the linkage between people's lives and institutions is only simplistically theorised (Toner, 2003). The definition of a livelihood by assets is considered as reductionism which provides only a superficial or static representation of people's livelihoods (ibid). Therefore, as encouraged by its authors (DFID, 2001) I have used the framework as a flexible tool with a focus on what is important for this particular case. In order to explain the differentiation of business strategies I looked into the role of different logics and capacities, rather than limiting the analysis to differences in access to particular assets. As explained above, by looking into different logics I acknowledge the fact that farmers with equal means can still make different decisions. Furthermore I chose for capacities rather than assets; as a capacity concerns the complete ability to execute a particular activity which often requires a combination of various assets. I explicitly recognise that farmers' capacities are not static, but that they develop over time and can be affected continuously by internal and external changes. Nevertheless, since the roles and forms of the five capital assets have been well developed by DFID (2001), I have still used the concept as Blumer (1954) once suggested, i.e. as directions along which to look rather than prescriptions of what to see.

By means of their capital asset approach, DFID (2001) stresses the importance of thinking about variations in livelihoods strategies between different social groups. Therefore, I explicitly linked socio-economic characteristics of the farmers to their business strategies when analysing the underlying factors of their business strategies. Tittonell et al. (2010) used a so-called principal component analysis (PCA) to identify non-correlated socio-economic indicators of their established household categories. I selected the socio-economic characteristics to be assessed in my research from the parameters of this PCA and after consulting my translator I added some locally relevant indicators to this[17]. Business strategy differentiation is a dynamic process and the current shape of strategies has been formed over time. Just providing an image of the status quo does not explain the processes that laid behind its formation, and therefore I also included an assessment of the main changes of farmers' production and marketing activities and the reasons and ways they used to realise that.

(Owusu-Gyamfi, 2009). The SL framework on itself is lacking in tools for market analysis and development, whereas the M4P approach used solely fails to include the holistic nature of people's livelihoods (Albu, 2008). A combined use would compensate for these gaps (ibid).

[17] The minimal socio-economic indicators I gathered for each household included: age of the household head, family members living and eating in the household, off-farm labour by family members, number and types of livestock, number of children attending school, possession of a mobile phone.

Irrigation system dynamics

A farmer's water use is directly linked to his/her business strategy, e.g. by the requirements on water availability and infrastructure that follow from his/her product mix, timing, and field size. However, farmers may also adapt their production system to the available water. Farmers producing okra and irrigated maize need less water than those producing vegetables, and even so a focus on production in the hot season demands more water than a similar production that is spread over the year. Woodhouse (2003) showed various cases in which new market opportunities led to a considerable intensification of smallholder farmers' water use. Any business strategy to make use of such opportunities requires the organisation of a sufficient water use, and farmers who fail to assure this will be limited in their benefit from such developments.

Water use principles

The essence of water use can be characterised as applying a water flow with a certain duration and frequency to the fields by means of a specific application method. The ability and willingness to adapt each of those features to the demands of a particular business strategy clearly differs among users. To adapt the flow discharge requires different actions than to adapt the timing or application method. The way farmers organise their water use will be discussed explicitly, since water is usually obtained by different processes than when purchasing other inputs. "The unique properties of water complicate the determination of rights, as patterns of water use are dynamic and complex" (Bruns et al. 2005, p. 5). Whereas inputs like fertiliser and pesticides are marketable products and thus characterised as private property, Boelens et al. (2005) characterise irrigation water as a common pool resource that is owned collectively. Hence, it could be expected that water use is not just shaped by individual decisions concerning one's financial resources, but rather by an interplay of natural and social dynamics that are partly beyond individual control.

Uphoff (1986) explains that water use consists of three elements, i.e. the acquisition, allocation and distribution of water. Acquisition refers to the activities of moving water from a source to the outlet serving the group involved (ibid). Individual household strategies to realise the acquisition of one's water resources could imply digging a canal from a source, or joining an existing canal system constructed by other farmers. Another option could be to rent irrigated fields from other farmers.

Water allocation is defined as the assignment of rights of access to water among users (ibid). Meinzen-Dick (2000) distinguishes water use rights, i.e. the right to access and use the water, and control rights, i.e. the right to control the management, exclusion and the alienation of rights concerning the irrigation system. According to Van den Dries (2002), individual water rights are based on specific water allocation principles. Schippers (2008) shows that in his research area, those principles correspond to the 'African irrigation paradigm' as defined by Bolding (2004), which among other things implies that water rights are based on the concept of hydraulic property. This concept has been established by Coward (1979) to explain that water rights are obtained by contributing to the construction and maintenance of irrigation infrastructure. Bolding et al. (2010) explain that usually a *dono do canal* ('owner of the canal') organises the construction of a canal to his land, and later more users join the canal who build up hydraulic property as well by participating in the canal's maintenance. Nkoka et al. (2011) state that farmers actually create a certain form of ownership of the system, on which the allocation of their rights is based. In the Mozambican Tsangano district, they distinguished three forms of farmer managed irrigation systems, each of them characterised by different governance patterns and types of ownership. In the Portuguese initiated irrigation systems, the government had allocated water rights and only members looking for an authority basis actively contribute to maintenance activities. Ownership and water rights in the communal irrigation systems are established by a mixture of investment, customs and social networks. In family irrigation systems the infrastructure and water rights are owned by members from one family, who usually tend to exclude others from interacting (ibid).

Finally, Uphoff (1986) describes water distribution as the actual delivery of water to the users at specific places, amounts and times. Hoogendam et al. (1996) point out that water distribution practices are not only shaped by

allocation principles, but also by water availability and current social issues among the water users. Strategies and contestation to get access to water can take place on both acquisition, allocation and distribution level.

Contestation over water

Bolding et al. (2009) point out that hydraulic property and the subsequent water rights are fluid over time and place. As a result, "various idioms of authority are mobilised to stake a claim on water flowing in an irrigation furrow" (ibid, p. 132). Such claims are based on arguments about people's investment in the construction and maintenance of infrastructure, but also on arguments about one's physical position in the scheme or one's social position within the community. Furthermore, claims that refer to the principle of giving each other a chance, and in exceptional cases court claims are used to obtain water rights. Certain actions executed to improve one's delivery can be justified based on the same type of arguments used to realise a desirable allocation of rights (ibid). Nkoka et al. (2011) show the particular importance of supporting social networks, in the sense that farmers use their relations to any form of authority in order to guarantee their control over water. The variety of strategies farmers use to assure their access to water reveals that next to a communal management process, water use also entails a dynamic socio-political process among individual water users that shapes water distribution and maintenance. Hence, irrigation system dynamics, i.e. the management and socio-political processes that frame water distribution and maintenance in an irrigation system, are continuously reformed by farmers' interactions that result from their attempts to organise and control their desired water use.

2.6 Research questions

This research should provide an answer to the following question:

How do different business strategies of irrigating smallholders in Chirodzo and Ruaca currently align to market opportunities and vice versa, and what is the impact of this difference in business strategies on irrigation system dynamics?

This question can be divided into four sub questions:

1. How is the tomato value chain constituted and what market opportunities does it provide to smallholder farmers in the research area?
2. How do farmers strategically organise their business to make use of those opportunities?
3. Which underlying factors explain the differentiation of business strategies?
4. What is the impact of different strategies on irrigation system dynamics?

2.7 Research methodology

I will now discuss the epistemology, research design and research methods by which I realised the study to answer the research questions.

Epistemology

The kind of data that would provide a scientifically valuable result to answer the research question is determined by the epistemology of the researcher (Mason, 1996). Personally, I feel most comfortable with a critical realist approach. A critical realist approach looks for linking mechanisms to explain the co-occurrence of certain phenomena. In this research I am looking for the linking mechanisms between the different component of farmers' business strategies and the underlying factors that explain them.

In my epistemology I recognise that there is a physical existing world out there, but I believe that human understandings of it, including my own understandings, are socially constructed. I acknowledge the fact that people have different understandings and experiences of strategies and markets and therefore I will combine my own observations and ideas with the accounts provided by the research participants. The described concepts are used as resources to make sense of the first data, but during the research I continuously reflected on what concepts were really helpful to explain the processes I encountered. Though limited to my own lens and assumptions, I aimed at using the described concepts in a flexible way in order to keep an open mind for

the perspectives of the research participants. This required both an in-depth study of the actions and interpretations of the research participants and a reflexive attitude towards the concepts and data collection methods used.

Research design

The research design that will be used is a case study research. As any concept, the concept of a case study has different meanings to different authors. Hammersley (1992) especially views it as a particular way of sample selection, while Yin (1994) argues that it represents a distinctive research design and methodology. I will follow Yin in the sense that I also believe that a case study is the most appropriate research design when the aim is to gain a deep understanding of why people in a specific situation make certain choices. This situation is referred to as a 'case', which is defined as a contemporary phenomenon in a specific context over which the investigator has little control (Yin, 1994). A case study examines phenomena in their natural setting rather than in an artificially created setting by researchers and explicitly considers the context of the phenomena being studied for the analysis.

As explained above, the particular unit of analysis of this research is a case study on farmers' business strategies. The case covers the irrigated area of Chirodzo and Ruaca, which is situated north from the village of Messica. Since I want to contribute to the MIPP project by this research, the exact geographical boundaries equal those of the MIPP project area. The MIPP project selected this area because of its high irrigation potential (MIPP, 2011).

Sampling criteria

The research units consist of twenty case study households, which have been specifically selected as I will explain below. Rather than selecting random households I made use of purposeful sampling, by which particular information-rich cases are selected in order to enhance their understanding (Patton, 1990). I made a selection of irrigation systems containing such information-rich cases, and proposed a number of users to be interviewed for each of them. The purpose-based selection was based on my preliminary interviews and the work of other students from Wageningen University who had done research in the area before, respectively Reumkens and de Boer (2011) and Krüger (2011).

I noticed during the preliminary fieldwork that there are in general three types of cropping systems in the area. One system uses canal irrigation to produce tomatoes, cabbage and other vegetables, another system uses naturally wet places to produce fruit, yam and sometimes sugarcane or groundnuts, and a third system produces non-irrigated maize or sorghum. Many farming systems include two or sometimes even all three types of those cropping systems. Therefore, by focusing my selection on farmers from canal irrigation systems, I also included an analysis of the other two cropping systems Nevertheless, I also analysed two farming systems that lack access to a canal, since I expected this to provide interesting insights in the role and value of water use, and the reasons why some people do not access canal irrigation.

Since water use formed an important aspect of my analysis of farmers' strategies, I included systems with different characteristics regarding water availability and the number of users in my selection. This implies that my selection includes both upstream systems in a river with a lot of water (Nhamaguere 1), and downstream systems in a river with little water (Godi 9). Next to that, both systems with few users and many users have been assessed. Moreover, I noticed during my first weeks in the field that single users have an advantage to users that have to share their canal with many others. Therefore, I also included some single users, two with large farms and one with a smaller farm.

On top of this, I made sure that the selection included at least some farmers that use credit (Ruaca 7) or showed some other feature of more investment than the average farmer, e.g. by using sprinkler irrigation (Nhamaguere 1). Moreover, a local bank *Banco Oportunidade* has provided credits to users of Chirodzo and Nhamaguere, so by including systems from both rivers in the analysis I also hoped to meet some farmers that

made use of that. Furthermore, I chose some systems from the area without associations (Ruaca) and systems from the areas with associations (Chirodzo), since Olwande and Mathenge (2010) explained that participation in groups increases a household's access to information which supports their decisions regarding production and marketing. Since, about half of the farmers in Chirodzo are a member of the union, I did not have to sample association members explicitly.

Before the fieldwork started I expected that accessibility would form one of the main parameters on which to base my sample, as Olwande and Mathenge (2010) explained that distance to roads generally has a negative impact on market participation. In order to test the hypothesis that this factor is very determining for one's marketing possibilities, I deliberately tried to visit some of the most remote systems in the area. I went to upstream river Makumbedze, which is even more north than Ruaca; but even there trucks had access. Moreover, scotch carts seem to be able to cross any kind of area, and therefore I did not encounter any farmer that produced less cash crops due to a lack of accessibility. Nevertheless, for the case study household interviews I have taken into account that costs may differ for farmers living at different distances from Messica, especially for those who lack own transport facilities. The exact criteria on which the particular irrigated systems have been selected can be found in appendix C.

This research does not aim at statistical generalisation within or beyond the project area. Rather, it aims to reveal the processes behind farmers' business strategies. Taking into account the outcomes of the research in the implementation phase of the MIPP project should facilitate a better understanding of other households as well, even though their particular strategies may be different than those assessed in this research. I consider it as a valuable asset to have in mind an understanding of how a particular process works in one case, in order to be able to verify its possible occurrence in other cases. Since I observed that the men were usually responsible for the decisions about a household's cash crop production, I decided to make men the central research units. However, I acknowledge the limits of not taking into account intra-household negotiations, and I will reflect on the impact of this in the end of this research.

Creating a typology of farmers' business strategies

A typology is defined as a procedure to design a system of types as a support to the analysis of a complex reality and the ordering of objects which, although different, are of one kind, e.g. farms (Landais, 1998). A farm typology describes the diversity of farm production units within a particular geographically bound area (Laurent et al., 1999). In general, typologies are an opportune technique "to describe the diversity of farm production systems whilst avoiding the pitfalls of singling out each and every production system as unique" (ibid, p. 192). They provide a framework to single out the aspects that need to be compared, giving meaning to these aspects in an intelligible group structure (ibid). Typologies can be especially useful to identify categories of households with common needs with regard to policy, programme and project interventions (ibid).

Some argue that typologies often lead to "inaccurate and misplaced generality that fails to engage with the complexity of local circumstances" (Ellis 1998, p. 7). However, typologies differ considerably at both fundamental and practical level (Whatmore, 1994). Most typologies serve as a frame for organising the gathering of references in the field and structuring these references (Landais, 1998). I used the typology for that same purpose, though I only determined the exact parameters on which to base the typology during the fieldwork. In all cases, the typology should reflect the logic of farmers' complete business strategies.

Research methods

Since this research does not aim at statistical generalisation but rather at a deep understanding of farmers' choices with respect to their production strategies and marketing engagement, the research will predominantly employ qualitative data collection methods. Qualitative research is carried out in order to investigate in what way or for what reasons things happen, rather than how many things happen (Green and Thorogood, 2009). Qualitative research covers a wide range of methods and is flexible in adding additional methods during the execution of the research (ibid). For the analysis of farmers' business strategies I used predominantly semi-

structured interviews and participant observation. Since contrary to the other chapters the market analysis chapter could also largely be read on itself, the methodology used for that will be explained in chapter 3.1.

Semi-structured interviews

The main part of this research consists of sort of semi-structured interviews with individuals from the selected twenty case study households. The interviews have been carried out in the field in order to combine them with observations. At the same time I also carried out GPS measurements of the irrigated and rain-fed area of each crop a farmer had cultivated in the year 2011, except when fields were situated at a different location. The households have been revisited in the second part of the fieldwork. I used a sort of semi-structured interview, in the sense that the researcher establishes the topics to be explored beforehand, but lets the responses determine the relative importance and the kind of information produced about each topic (Green and Thorogood, 2009). This forms a contrary to structured interviews, in which all exact questions and their order are determined beforehand, and in-depth interviews, which completely leaves the time and importance of each issue to the interviewees (ibid). According to Hammersley and Atkinson (2007), interviews can be used in two complementary ways; they provide accounts which can tell you something about a phenomenon and they can be used to analyse the perspectives of the participants. If for example, a farmer talks about water scarcity all the time, this indicates that it is an important issue to him or her. I realise that interviews provide information about the accounts of people rather than about real phenomena. However, since it is practically impossible to be present at all relevant activities in order to observe phenomena yourself, interviews are usually the best option available. In case of data saturation, I decided to adapt my questions and eventually skip certain topics. This usually happened with respect to the market analysis, but not much in the interviews about farmers' business, as all of them have their own logic and practices.

Observation

During the interviews I have observed the studied farms and irrigation schemes. Next to this I paid specific attention to indicators of increased wealth, such as a big house or motorbike. Observation has the main advantage compared to most other data collection methods, that you do not get people's accounts of a situation, but their real actions (Green and Thorogood, 2009). Furthermore, the data are not limited to language, but can also include observed behaviour, settings or objects. Observation can allow for data gathering about different dimensions, i.e. the space, actors, activities, objects, acts, events, time, goals and feelings (Spradley, 1979). This is hardly possible with any other data collection method. Another main strength of participant observation is that it can have an inductive function, since it can inform a researcher on new relevant aspects to include in the research. This was particularly useful in the initial phase of my research in which I still had to identify important actors and factors to include in the assessment.

In the studied irrigation schemes I have used observation to get a global view on the farmers' interactions, crops grown, equipment use, the irrigation infrastructure and differences in water distribution between users. Considering the typology of research roles established by Gold (1958), I employed the 'observer as participant' role. This is, while observing I interacted with people and even carried out my interviews, so the research participants clearly knew that I was conducting a research. However, I did not spend that much time in each community to be able to take the role as a 'participant as observer' or 'complete participant'.

Research strategy over time

I daily conducted fieldwork from September 5th till December 2nd 2011. I used the first three weeks to familiarise myself with the research area and to make a deliberate selection of case study households. Then, I used five weeks to execute the first interviews with all case study households. During the whole research period, I eventually interviewed market actors as well. After two weeks of only interviewing market actors and analysing the interviews with farmers, I started to revisit the case study households for a second interview. I was then sick for 1.5 week and after that I conducted structured interviews at various markets for about one week. In the two weeks that left I continued with the household revisits and carried out daily price monitoring in Messica.

3. Tomato market analysis

Nearly all smallholder irrigators in the research area produce cash crops and for the majority of them tomatoes are the most important crop. By means of their tomato production farmers have become engaged in both the tomato input and output markets. In this chapter I provide an overview of those markets in order to explain what market opportunities there are and how farmers make use of that. I start by describing the development of the research area into an area known by traders for its quality tomato production. Then I briefly explain what actors are involved in the input market output markets. I continue by explaining the high price variability in the different stages in the tomato output market, and show that only a limited part of the farmers is able to benefit from the highest prices in time and location. I discuss the marketing practices at field level and at the different wholesale and retail markets. Finally, I show that tomato production in the research area has generated a considerable increase in income for both farmers and traders, even though most farmers have not used all opportunities to maximise this.

3.1 Methodology

Research design and methods

To analyse the tomato market I have made use of a value chain analysis as explained in chapter 2.5. The research units for this are farmers, key market actors and service providers, who I mainly approached by semi-structured interviews[18]. My methodology corresponds to the ideas of Ferris et al. (2006) who state that a big sample size is not a critical issue for value chain analyses, but rather the use of key informants and the process of gaining a feeling for how the market operates. "Key informants are people who have a good understanding of the market situation from their position in the market chain" (ibid, p. 13). Beyond the price monitoring and structured interviews described later in this paragraph I held semi-structured interviews with 9 input suppliers, 2 transporters, 9 wholesalers and 20 retail sellers in Messica, Manica and Chimoio. Furthermore I obtained detailed information on the marketing activities of 20 case study household farmers by repeated semi-structured interviews, which is explained as a research method in chapter 2.6.

In the first interview phase I focused on the suppliers and buyers of tomatoes of the interviewees in order to identify the market actors in the chain. At the same time I discussed the tomatoes in terms of price and quality in order to verify the aspects I should look at when observing a particular type of tomatoes. The information obtained through this phase was later confirmed during a meeting with a commercial tomato farmer who explained about tomatoes and its different markets in Chimoio[19]. Later, I analysed the relations and agreements among the different market actors into more detail and assessed the particular activities of each market player. I often interviewed at the market to observe traders' practices, however any time I encountered a trader or transporter in the field I explicitly interviewed them as well in order to observe their behaviour regarding the farmers they buy from. By interviewing market actors throughout the chain I could triangulate ones answers with information provided by his/her buyers or suppliers.

The possibility to cross-check information is also essential for assessing the price of tomatoes and the distribution of added value along the different stages in the market chain. Nevertheless, the fact that tomatoes are characterised by high price variability implies that such cross-checks should actually be taken on the same day. Therefore, for a period of ten days I executed daily price monitoring at both the field and the local market in Messica, respectively by asking my translator David Muchena[20] for the day price of a box of big tomatoes and by writing down the sales price of tomatoes of 20 retail sellers. At the same time Piloto Rodrigues, the local

[18] The choice and characteristics of semi-structured interviews are described in chapter 2.6.

[19] On 06/11/11 I visited Cota Benade together with my supervisors Gert Jan Veldwisch and Wouter Beekman. Cota is a white Zimbabwean farmer producing tomatoes near Chimoio.

[20] David Muchena is a tomato farmer in the research area as well; and since each day farmers discuss the price one got for his/her tomatoes he could inform me about this daily.

administrator in the MIPP project[21], monitored the prices of about 11 sellers at both the *Catanga* wholesale market and *Bazar Central* retail market in Chimoio. With those data I could assess both the daily price variation and the added value in different steps of the value chain. I did not include the sales of small tomatoes in those calculations, because about 60% of the production from the case study household farmers I interviewed concern big tomatoes and the prices discussed among farmers normally concern big tomatoes as well. Moreover, in Chimoio and Manica I focused my analysis on the central markets, whereas most small tomatoes are sold at the various small markets in the towns' different neighbourhoods. Hence, researching big tomatoes was a more practical option than researching small tomatoes.

Additionally, I prepared questionnaires that I executed as structured interviews with respectively 22, 19 and 11 sellers at the *Catanga, Trinta e oito* and *Bazar Central* market in Chimoio and with another 11 sellers at the local market in Messica[22]. The structured interviews were mainly used to get an overview of the tomato flows throughout the year. Therefore I asked traders for each month about the products they sell, the origin, purchase location and supplier of their tomatoes and the price they pay for one box of big tomatoes. With respect to the year-round prices I consulted traders rather than farmers, because traders sell tomatoes the entire year whereas most farmers do not. Moreover, since traders are grouped together at one market spot it is more practical for executing many structured interviews within a short time. Besides, the structured interviews covered some quality characteristics of the tomatoes the sellers had bought and the rate of their sales. Combined with the price monitoring data and information from the interviews about the costs that different actors face, this also allowed me to estimate the profit that the particular market actors make.

Reflection

Reflecting on the research I view the market chain analysis as the most tough part of the research, and I consider the following quote from Hill (1963, p. 455) as a meaningful indication of the experienced difficulties: "It is not so much the heat, the glare, the bustle, the over-crowding, the noise, the shouting, (and consequent hoarseness), or even the sneezing caused by open bags of pepper and maize (for all this is compensated by the very courteous behaviour of Africans in markets)- the difficulties are rather the extreme fluidity and complexity of the undocumented situation and the need to trouble informants at their moment of maximum anxiety, when they are concluding transactions". Indeed the dynamic circumstances combined with the variety of different sales units and qualities, let alone the price variability among different times and locations, complicate a sound comparison of prices among different market actors. The resulting focus on big tomatoes sold in specific units was an obligatory strategy to make sense of the data, however I recognise the fact that this has an impact on the quantitative information I will present. The same accounts for the use of particular 'model' farmers and traders to estimate the distribution of added value among different market actors. One should realise that in fact individuals are pretty diverse, especially with respect to the number of boxes traded, and therefore the information should only be used to get a rough idea about the proportions.

A second problem with market research is the fact that prices concern actually sensitive business data that actors do not want to share. The fact that some traders knew I worked with farmers contributed to their hesitation even more, and as a result I cannot guarantee the veracity of the prices I have been told. I asked for both purchase and sales prices at various levels in the market chain to verify, however the daily price variation prohibited the comparison of prices monitored of different days. Therefore, the daily price monitoring for ten days is the only data set I could use to point out the price variation within the value chain. It should be noted that during any other period of the year, both prices and the relative distribution of profit among the different market actors may be different.

[21] Piloto Rodrigues has extensive experience in assisting and translating researches mainly on farmers in Mozambique and Zimbabwe.
[22] The questionnaire can be found in appendix B.

Finally I would like to stress the importance of combining structured interviews with semi-structured interviews. I acknowledge the value of the high number of participants that can be interviewed by structured interviews, however I consider semi-structured interviews as an essential addition to make sense of the data. For instance, the structured interviews with retail sellers on a market in Manica indicated that many sellers do not sell tomatoes from December till April. I expected this had to do with the scarcity of tomatoes and increased prices in that period, which retail sellers could not afford to purchase. However, when I talked to a trader I discovered that it was actually the rain destroying their market stands and the need to work on their maize fields that kept them from selling in that period. Hence, in my opinion the use of only questionnaires or structured interviews can easily lead to wrong conclusions, as it does not allow for a sound understanding of the researched processes.

3.2 Local market developments

In chapter 2 I explained that the research area is a relatively densely populated area. After the war in 1992, many farmers who had fled to Messica, Zimbabwe or other areas came back to Chirodzo and Ruaca to restart their farms. At the time most farmers had a diverse farming system to produce maize and vegetables for their own consumption. Some farmers sold part of their products at the market in Messica, as for instance explained by the following farmer from Ruaca.

> [JK]: I started producing beans and tomatoes in 1992. From 1992-1996 it was hard to sell tomatoes. I used a scotch cart to sell at the market in Messica.
> [BvdP]: What changed after 1996?
> [JK]: More people got a scotch cart so it became easier to find one. I also got more cows for ploughing the fields.[23]

Nevertheless, most farmers indicated that they only cultivated small fields because it was hard to carry all products to Messica. Around the year 2000, urban traders started to enter the area and buy tomatoes at the farm-gate[24]. In response, several farmers started to gradually increase the size of their tomato fields. Since the traders were mainly interested in buying tomatoes, many farmers started to focus on this product. Over time they also adapted the tomato quality to the market, as explained by the following farmer.

> [BvdP]: What type of tomatoes did you grow first?
> [PM]: Before 2007 we were growing poor types of tomatoes and now quality tomatoes, because customers didn't like poor quality tomatoes.
> [BvdP]: How did you find this out?
> [PM]: The first time at the road we were able to sell poor quality tomatoes, but after that the customers did not want to buy it anymore, and so we changed to quality tomatoes.[25]

Next to quality seed, farmers also started to use fertiliser and pesticides which they bought in town, and later became available in Messica as well. However, farmers explained me that this was also a response to the declining productivity of the soil and increasing occurrence of pests. The market development process was self-propelling, as a higher and better quality production attracted even more traders. Currently, the area has developed a reputation of quality tomato production, as for instance explained by the following wholesale tomato trader from Manica.

[23] Field notes 22/11/11
[24] The construction of the road from Messica to Ruaca by the government was mentioned as the main reason for this, however some farmers said this road was only constructed in 2007. I am not sure of this; maybe in 2007 it concerned a major improvement.
[25] Field notes 13/09/11

[BvdP]: Is there a difference in quality between tomatoes from Chirodzo and other places?
[AM]: The quality in Chirodzo is better, because the farmers there use all the pesticides and fertiliser that the plants need.[26]

Since wholesalers coming to the field are almost exclusively interested in tomatoes, there are many farmers who do not produce any other cash crop. My translator explained that because last year the tomato box price did not decrease to less than 100 Mts[27], this year even more farmers started to grow tomatoes. During the period of fieldwork however, I met several farmers who told me they would actually shift to other crops, because the prices were extremely low this year. Hence, farmers started their cash crop production as a response to the local market development, and they keep on adapting their production to this market. However, over time farmers have developed different business strategies to respond to the market opportunities that have arisen. In this chapter I will show the current tomato market opportunities, so that in the next chapter I can explain how farmers have made use of that in different ways.

3.3 Input markets

Tomato production in the research area is a relatively intensive culture compared to other crops. All farmers I interviewed use at least one kind of pesticide, and the majority also buys seeds and fertiliser for his/her tomato production.

Pesticides and seeds

Farmers use both generic and specific pesticides against caterpillars, flies and red spider mites[28]. Next to that most of them use some protective chemicals, e.g. to protect the plants against cold weather[29]. With respect to seeds, only 2 out of 16 farmers use their own whereas the rest buys their seed. None of the pesticides or seeds they buy is produced in Mozambique; most pesticides come from South Africa and most seeds from Zimbabwe. Most farmers buy their pesticides and seeds in the shops *Hygrotech* or *Savon Trading* in Chimoio[30], which is the cheapest option even if transport costs are included. However, some farmers also buy their products from shops in Manica or Messica[31], or in very small amounts from some rural sellers. Especially the latter is relatively expensive, e.g. 125 mL of Tamalon cost 120 Mts at a rural seller, whereas in a shop in Chimoio it costs 450 Mts/L. Nevertheless, some farmers prefer to buy small amounts because they do not use a lot and they want to save on transport costs.

Most input shop operatives I interviewed were not very willing to talk to me about their selling and purchase prices. However, I got insight in the different prices form the farmers who told me the price they paid at the particular shops. I noticed that the unit price of larger packages is clearly lower than smaller packages. Since on top of that farmers all pay individual transport costs, the inputs constitute a considerable production cost. The farmer's union to which about 50% of the farmers belong does not coordinate any purchase of inputs. Since the managers of the *Savon Trading* and *Pannar* shops both indicated that farmers can get discount when

[26] Field notes 27/10/11
[27] During the period of fieldwork, 100 Mozambican Meticais (Mts) equalled the value of 2.8 Euros.
[28] Most farmers use tamalon against caterpillars and flies and supmectin (20% active substance) against red spiders, and some use dimethoate (40% active substance) against any insects.
[29] Most use maxebo to protect the leaves from cold weather and some also use Cobox (85% active substance) for healthier leaves.
[30] *Savon Trading* sells pesticides from both the agencies *Agrifocus* and *Syngenta*, which produce their products in respectively South Africa and Switzerland. Their seeds are produced by *Prime Seeds* from Zimbabwe. The *Hygrotech* store in Chimoio closed its doors during the period of fieldwork. Some farmers also buy from the *Pannar* store in Chimoio, which sells the *Starke Ayres* seeds that they produce in South Africa.
[31] Some of the shops in Messica and Manica have the same owner. Most of their products also concern *Agrifocus* pesticides and *Prime Seed* seeds.

buying big quantities in one time[32], this provides opportunities for farmers with respect to collaboration in the purchase of their inputs.

Fertiliser

The majority of the farmers also use fertiliser, which is exceptional in the Mozambican context. They use both phosphate and ammonium-nitrogen, which they buy mostly in bags of 50 kg for about 1,200 Mts at the market in Manica. At this market there are about 3 stands where people sell fertiliser. The sellers told me they buy the bags for 950 Mts at the factory in Gondola and that they pay another 50 Mts to transport them to Manica. However, one farmer buying directly at the factory told me he only pays 850 Mts per bag. Like this farmer there are some more people who buy at the company and sell to farmers at the field. They usually sell a bag for 1,000 Mts, but since they transport them by minibus and scotch cart the amount of bags they can buy and sell is only limited. Such farmers or rural traders also sell fertiliser in small amounts; a gallon of 5 kg then costs 125 Mts. The fact that anyone can just buy a few bags at the factory provides the opportunity to reduce costs on fertiliser, however the problem with this is that at the factory the fertiliser is often sold out and that it is not possible to phone them in order to check this.

In short, the market chain of the pesticides and seeds consists of relatively a lot of actors, which partly explains the fact that farmers pay a wide range of different prices. Since on top of this the stores sell many different products, some farmers do not have a sufficient overview to identify the best purchase opportunities. Clearly, farmers can save a lot by coordinating the purchase of their inputs with some other farmers. The fertiliser is produced relatively nearby and therefore farmers can even buy directly at the factory. The fact that this is only done to a limited extent also provides opportunities for farmers to save costs on inputs.

3.4 Tomato value chain analysis

A market chain consists of various actors that add value to a product. In this chapter I describe the relations between the actors that add value to the tomatoes produced in the research area. I first provide a quick overview of the actors in the market chain. Then, I explain the formation of prices and show that price variability is very high on both an annual and daily scale. Next, I discuss the practices of transactions at the field, local and urban wholesale markets and retail markets respectively and finish with an overview of the generated value by the different actors in the market chain.

Overview tomato value chain

The tomato value chain involves many actors, and a tomato has often passed through one, two or three different traders before reaching the consumer. It is interesting that practically all traders, wholesale and retail, are women. Figure 6 shows the various actors who trade in tomatoes from the research area.

The transactions are depicted by stars at a certain location, from left to right respectively on the field, local wholesale market, urban wholesale markets and retail markets. The line representing sales by farmers at the wholesale market in Manica is dotted, because there are farmers who sell there but I did not meet anyone from the research area who does that. Wholesale traders from Beira are not included, because of the limited presence and temporal character of their activities in the area.

[32] The manager of *Savon Trading* mentioned the possibility of a 5% discount, but at the *Pannar* store I saw a price list that showed about 10% discount on big purchases and 20-30 % discount in case of a contract agreement.

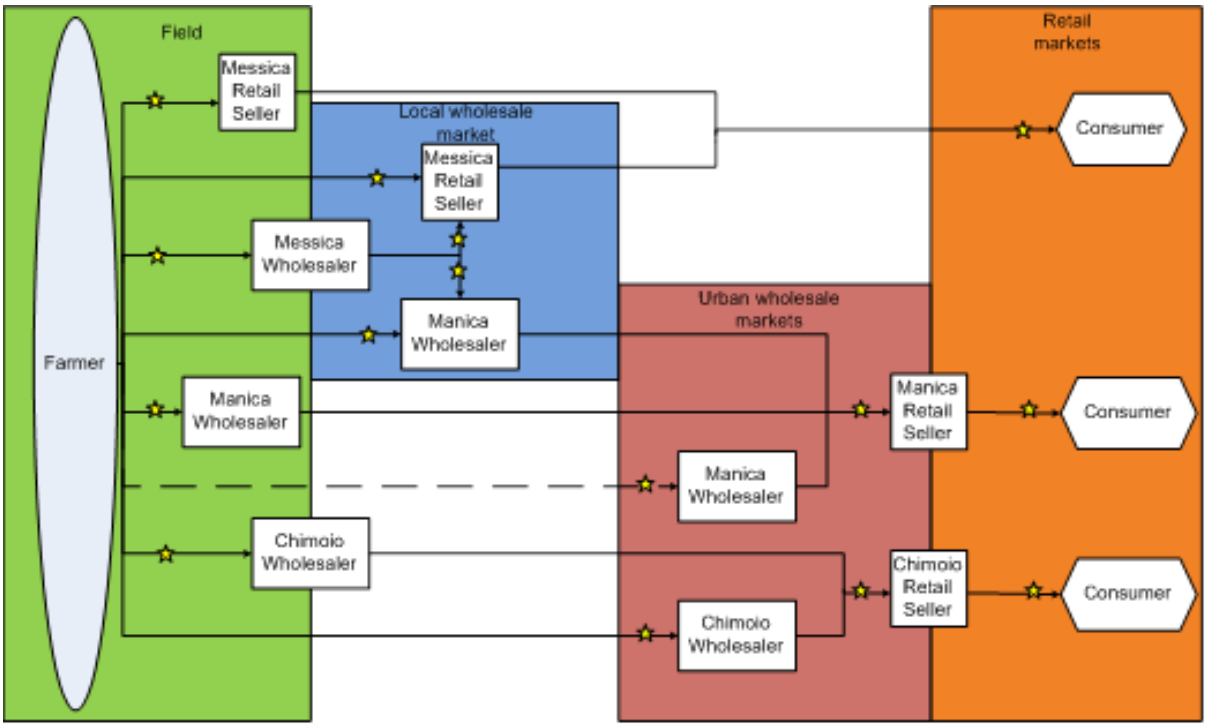

Figure 6 Actors in the value chain of tomatoes produced in the research area

The figure shows that tomatoes are sold 2 to 4 times before reaching the consumer. Most tomatoes are bought at the farm-gate by wholesalers, who transport them to a wholesale market in Messica, Manica or Chimoio, from where they sell mainly to retail sellers[33]. Those retail sellers carry the tomatoes to particular retail markets and sell to consumers. The figure depicts sellers from different markets in a town as one box, but in the paragraphs below I will explain that in fact those can concern a variety of different markets, especially with respect to the retail markets. Figure 7 shows the location of the different markets.

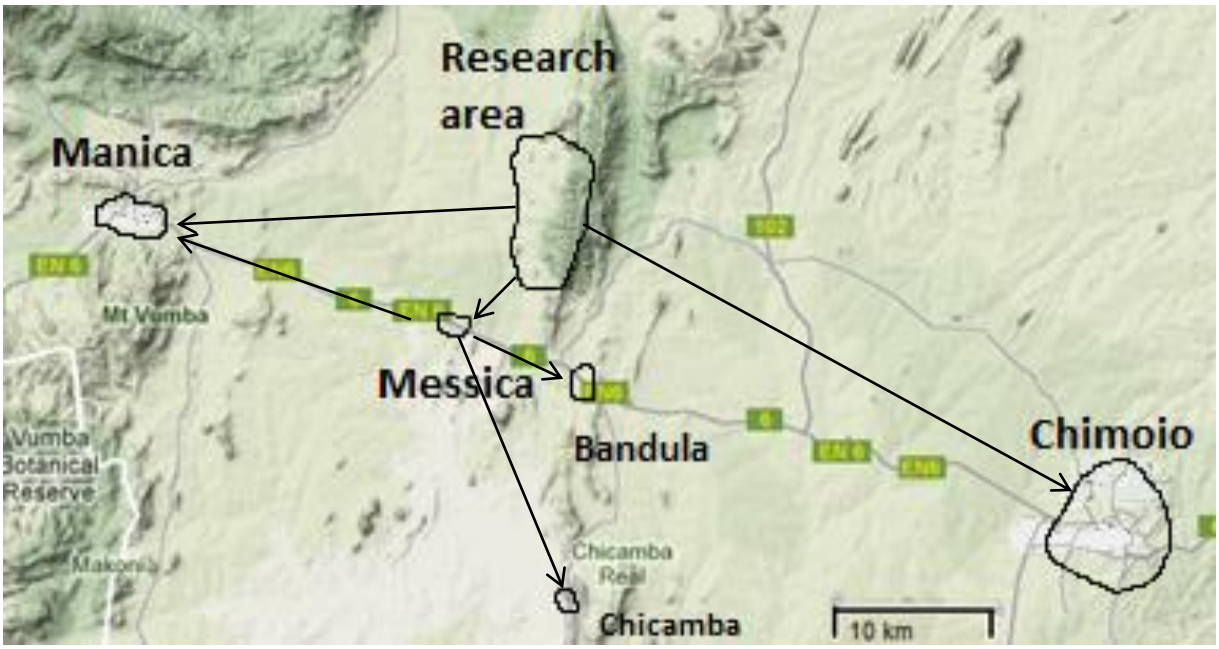

Figure 7 The main tomato flows from the research area

[33] At the wholesale market in Messica tomatoes are also sold to other wholesalers, e.g. from Manica.

The arrows show the destination of the tomatoes rather than the exact road travelled. After being sold at a wholesale market the tomatoes are spread by retail sellers throughout the indicated areas of Manica, Messica and Chimoio, and to a less extent also in Bandula and Chicamba.

Most tomatoes produced in the area are destined for the markets in Chimoio, of which the major part is bought at the farm-gate by wholesale traders who sell to retail sellers in town. Only few farmers bring their tomatoes to the Chimoio wholesale market themselves. Besides that, most tomatoes are sold at the farm-gate to wholesalers from Messica, who sell at the local wholesale market to retail sellers from Messica and wholesalers from Manica. Wholesalers from Manica both buy their tomatoes at the farm-gate, the local wholesale market and from farmers coming to the urban wholesale market in Manica, although those farmers are not from the research area.

Pricing and price variability

The tomato market is characterised by high price variability over time. The high temperatures and lack of cooled storage facilities imply that tomatoes should be consumed within less than a week after the harvest. As a result all actors in the tomato market chain are forced to sell their tomatoes relatively quickly, which leads to sudden price decreases in case of a peak harvest period. In the same way scarcities can increase prices more than ten-fold. Obviously, the price of tomatoes also increases when moving along the market chain from field level to wholesale and retail markets. Besides this, the quality of tomatoes accounts for differences in price as well. In this paragraph I first discuss the role of quality on price formation and then show the price variability of tomatoes in time and at different stages in the value chain.

Quality

Most farmers and traders refer to the size of tomatoes when talking about quality. If farmers sort, they usually distinguish big and small tomatoes. Traders buying a box of big tomatoes then usually sort again into big and medium tomatoes. Therefore, when I speak of 'big tomatoes' in this paragraph it also includes those tomatoes that traders would classify as 'medium tomatoes'. Farmers repeatedly told me that there is no difference in price among the various varieties. Traders consider all varieties grown in the research area as 'quality tomatoes', though with different characteristics. The following quote of a retail seller at the local market in Messica who mainly sells big tomatoes illustrates a trader's perception on quality.

> [BvdP]: What do you look at when buying tomatoes?
> [An]: I look for quality first. It is not good to buy small tomatoes.
> [BvdP]: Do you only select on size or also on type?
> [An]: On both. I prefer Roma and China tomatoes. Roma tomatoes include several types like Rio Fuego, and they last a long time. China tomatoes are the Roma VFN type; those tomatoes do not stay for a long time, but customers like the sweet taste.[34]

Even though most varieties that farmers produce concern Roma tomatoes, I observed that only few tomatoes pronouncedly feature the particular oval Roma shape. Those tomatoes were sold for higher prices on the market, as for instance indicated by a wholesale trader at the *Catanga* market in Chimoio who told the prices of her 30 kg boxes.

> [Ca]: I now sell big round tomatoes for 350 Mts and big Roma tomatoes for 450 Mts.[35]

Apart from the incidental occurrence of this type I did not notice any main price difference among different tomato varieties on the various markets I researched. Therefore, I based my analysis of tomato prices on all other tomatoes and only differentiated by the size of tomatoes; as a box of big tomatoes has about three times the price of an equally-sized box of small tomatoes. Since consumers look both for green and mature

[34] Field notes 13/09/11
[35] Questionnaire 19/11/11.

tomatoes[36], there is no price difference according to the colour of the tomatoes. Prices only go down when the tomatoes are starting to decay.

Monthly variability

Since most tomatoes produced in the research area are directly bought by wholesalers from the *Catanga* market in Chimoio, prices in the area are strongly linked to tomato supply and demand on this market. Since farmers use the rainy season to cultivate maize, most tomatoes are produced from May till November. Especially September and October concern a peak harvest period that is characterised by extremely low prices. In contrast, during the rainy season the low production volumes and bad condition of dirt roads forces traders to buy part of their tomatoes in other regions which drives up prices to a peak from December to February.

The following figure shows the average price per month of boxes with big tomatoes sold at the field and on the *Catanga* market respectively. It should be noted that despite displaying the annual tendency, the figure may show weakened values since both graphs concern averages of prices mentioned by 25 traders. Moreover, it does not accurately reflect the daily variability within a month. Real box prices can be more extreme, as individual transaction prices at farm-gate ranged from 40 Mts in October to 600 Mts in January, and at *Catanga* the price even went up to 1,000 Mts at some stage.

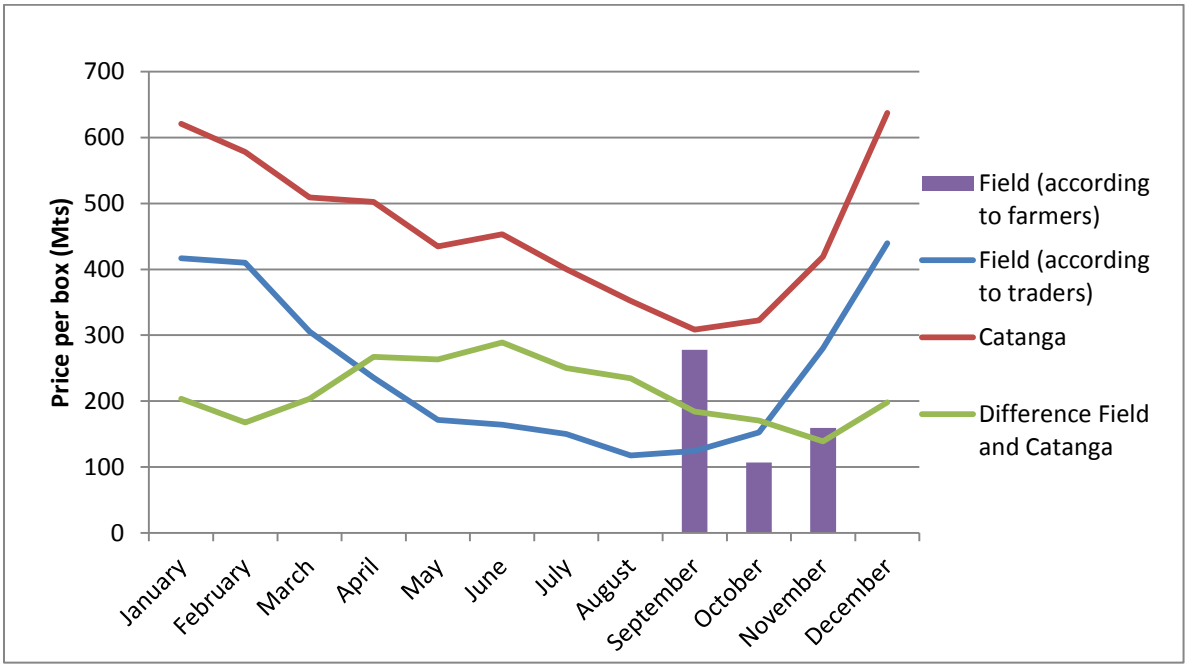

Figure 8 Monthly price variability of boxes of big tomatoes on the field and the *Catanga* market in Chimoio
The field price graph is based on monthly data of about 25 traders from *Catanga,* and the *Catanga* price graph on purchase data from 25 traders of the *Bazar Central* and *Trinta e oito* markets in Chimoio[37]. The columns show the average price obtained by farmers during the period of fieldwork based on respectively 7, 6 and 26 transactions in September, October and November.

The figure shows that prices on the field and the *Catanga* market follow the same tendency throughout the year. The difference is about 200 Mts. The fact that some individual traders mentioned very different prices implies that those data may not be totally accurate. Therefore, I will not draw any conclusions from details within the graph. The columns show that prices mentioned by farmers are higher than those mentioned by traders in September and lower in October and November. The difference may be caused by the fact that the

[36] Green tomatoes are often used in salads.
[37] I asked the traders what price they pay for a box of tomatoes each month. Since I also asked them where they buy their tomatoes each month, I could constitute the average prices of boxes bought at the field and *Catanga* respectively.

data from farmers concern specific transactions that took place in the period of fieldwork, whereas I asked the traders about the usual price in each particular month, not specifically for the year of fieldwork.

Daily price variability

The daily tomato price is much more variable than the monthly averages show. Figure 9 shows the daily prices obtained for a box of big tomatoes by farmers in the research area during the month of November.

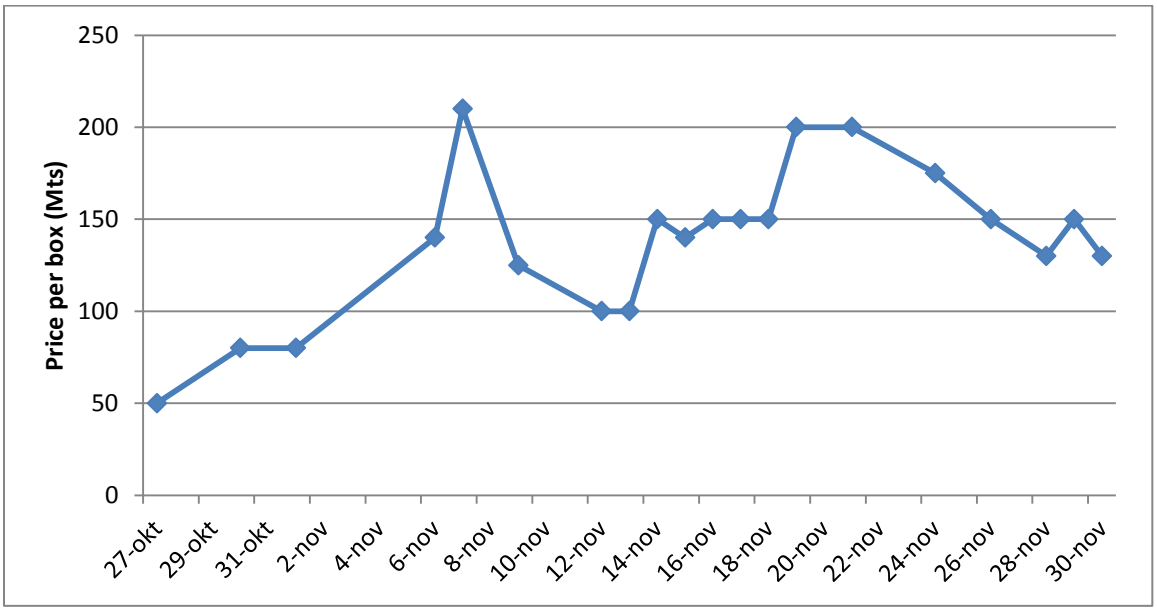

Figure 9 Daily price variation of a box of big tomatoes

The graphs concerns the price at the farm-gate obtained by farmers in the research area. It is based on average day prices of 20 days. I daily consulted my translator on the tomato price, since as a farmer he discusses the prices with other farmers nearly every day.

The figure illustrates that within a couple of weeks prices can gradually double or even quadruple from 50 to 200 Mts per box, which obviously has a major impact on a farmer's profit. Daily price monitoring in the period from November 21st till December 2nd 2011 indicated that on retail markets in Messica and Chimoio (*Bazar Central*) prices remained constant[38]. With respect to the impact of the time of monitoring, the Messica market was the only location where sellers offered a bit more medium and small tomatoes for the same price in the late afternoon, compared to the morning or early afternoon. Price monitoring during that same period on the *Catanga* market did not generate sufficient data to assess the exact price variation on that market.

Nevertheless, like at the farm-gate prices vary daily at *Catanga*. Since the tomato supply is not coordinated[39], days of a low or high tomato delivery occur regularly and as a result prices can suddenly rise or drop. Though the big commercial tomato producers around Chimoio who produce for the same market can be expected to flood the market whenever they deliver, this seems the case for any tomato delivery that takes place at *Catanga*[40]. In case of very high temperatures prices also rise, since then tomatoes decay more quickly. Since all wholesalers have their stands next to each other, prices are directly communicated from one to another.

Sales at field level

An overwhelming majority of farmers sell their tomatoes to traders that come to their field. Wholesalers, either from Messica, Manica, Chimoio or Beira, usually buy from a farmer during the whole harvest period of

[38] Based on daily tomato prices of 20 retail sellers at the Messica market and 11 retail sellers at the *Bazar Central* in Chimoio.

[39] Even though about 50 per cent of the farmers are a member of the farmer's union, there is no joint planning on planting or selling. The few big commercial farmers around Chimoio do not coordinate their timing either.

[40] The supply of one big commercial farmer of about 65 boxes a time equals that of trucks coming from the research area.

his field, which can vary from 4 weeks in November up to 10 weeks in May due to the difference in temperature. In contrast, the retail sellers from Messica buy from any farmer they encounter, since they only buy a few boxes that they carry to the market. Wholesalers usually rent a truck and buy from several farmers at a time[41]. The fact that a wholesaler from Chimoio buys about 25 boxes per week, whereas a retail seller from Messica only buys about 2 boxes per week largely explains why the largest volume of tomatoes is destined for Chimoio. Wholesalers from Manica also buy large amounts; but since there are only few of them their relative share is still pretty low[42].

In the week before the first harvest, most farmers talk to the traders that walk around and make an appointment to harvest. Such appointments are not always respected, but since there are many tomato traders in the area this is never a big problem. Farmers with a phone usually have a few numbers of traders that they call to make an appointment[43], and occasionally traders also call them. Sometimes the price is already discussed on the phone, but due to the high daily variability the price is often adjusted when the transaction takes place. Since farmers discuss the prices amongst each other there is kind of a local 'day price' within the whole area. The traders from different towns all pay the same price, but since most tomatoes are destined for the *Catanga* market, those traders sometimes consciously undervalue the market price[44]. Anyhow the price depends on a negotiation, like in the following discussion I observed between my translator [DM] and a trader [Fe].

> [DM]: How much do you pay?
> [Fe]: 150 Mts.
> [DM]: You can go. My tomatoes are 200 Mts.
> [Fe]: 180 Mts.
> [DM]: 200 Mts.
> [Fe]: Okay, 200 Mts is okay.[45]

On the same day, we also met a farmer who did actually sell a box of big tomatoes for 150 Mts. So, not all farmers have the information and skills to successfully deal with such negotiations, and therefore they can get paid below market price. Since farmers who sell from the farm-gate are fully dependent on price information from traders and other farmers, they cannot verify the price at *Catanga*. Occasional trips to this market or contact with relatives from Chimoio cannot prevent this due to the high daily price variability.

My translator explained to me that farmers are in a better negotiation position in January and February because there are fewer tomatoes then. This also influences further marketing practices, since whereas traders from Chimoio usually pay farmers a week after the harvest, in January and February they pay directly. The payment terms form an important difference among the different traders, since traders from Manica and Messica do pay directly upon collection of the produce during the whole year. As a result, farmers would prefer to sell to those traders, but as explained the volumes they buy are relatively small. Therefore, most farmers with large tomato fields only sell to traders from Chimoio.

Most wholesalers from Chimoio provide some farmers they buy from with inputs on credit. Farmers refer to such traders as 'special customers' and accord those traders the first right of buying. The traders benefit from

[41] Wholesalers from Messica use smaller trucks or a scotch cart and therefore buy from fewer farmers at a time.
[42] The same accounts for wholesalers from Beira. Although many wholesalers operate in Beira, only few of them buy their tomatoes in the research area. The one I interviewed indicated he only buys in Chirodzo from August to November because after that the road gets bad.
[43] Some farmers also phone traders to ask them to bring something from town, such as inputs, fish or cement.
[44] I once observed a trader from *Catanga* who came to the field and said that in Chimoio they sell boxes [30 kg of big tomatoes] for 80 Mts. (Field notes 10/10/11). However, two days before I was at *Catanga* and saw that prices were around 80-100 Mts for a 'gallon' of 3 kg of big tomatoes and 250 Mts for a box of medium tomatoes (Field notes 08/10/11). This is either an example of major daily price variation or of the practice of traders to undervalue the market price.
[45] Field notes 25/11/11

this when there are only few tomatoes in the area, and meanwhile farmers benefit from a guaranteed buyer in periods of abundance and from the possibility to produce without initial capital. Farmers decide which and how many inputs they need and pay the same price as they would do in the shop in Chimoio. This amount is deducted from their harvest revenue later. Even though it often concerns a considerable investment the agreement is purely verbal. Some farmers do not want to engage in such agreements because they expect to get a lower price then, but others disagree with that as for instance explained by the following farmer who gets all his inputs on credit.

> [BvdP]: Can you still negotiate if you have to sell to that trader?
> [TS]: We negotiate about the price at harvest time. It depends on the price of that day. If the price is 250 Mts I will also sell to her for that price.[46]

The harvest and transport to the truck is usually executed by a farmer together with family members or day workers. Traders from Messica usually harvest themselves. In Chirodzo the wholesale traders pay for all helpers except for the farmer himself. However, the following quote by a farmer from Ruaca suggests that this may be different there.

> [BvdP]: Do you get a higher price when customers do not harvest themselves?
> [JK]: No, they pay the same price.
> [BvdP]: Why are you working with them?
> [JK]: Sometimes the customers just come and say: 'we leave the boxes here while we will look for other farmers, and you can fill them'. If the customers ask me to look for people to help then they will pay them, but if they don't ask so I will pay the workers myself.
> [DM]: There are other customers coming here than to Chirodzo, so they can make other agreements.[47]

The latter phrase indicates that some traders usually buy in Chirodzo whereas others normally go to Ruaca. As a result, in Ruaca traders can make agreements beyond the norms in Chirodzo, e.g. with respect to the payment of harvest labour. Though this may have to do with the fact that Ruaca is situated a bit further away from the main road, I could not get a clear view on the importance of this.

About half of the farmers sort their tomatoes in big and small ones in order to obtain a better price for their big tomatoes. However, particularly farmers who sell to traders that harvest themselves do not do so. Some traders sort the tomatoes on the field as well, but most farmers prefer to do it themselves, as explained by my translator when we talked about sorting.

> [DM]: If the customers sort themselves, they will put big tomatoes down and some small on top if you don't look and then pay a lower price.[48]

In short, nearly all farmers basically face the same marketing conditions of selling at the farm-gate without detailed price information. In chapter 4 I will explain that some details can vary according to the particular business strategy of the farmer, but only few farmers practice the considerably different approach of selling at the wholesale markets themselves. Sorting into big and small tomatoes is basically the only value adding activity performed by farmers beyond production.

Local wholesale market

The main part of the tomatoes is sold for the second time on a wholesale market. The local wholesale market is situated near the main retail market in Messica. This market is supposed to be occupied two mornings a week, but sometimes tomatoes are sold on other days as well. Both wholesalers from Messica and some farmers sell

[46] Field notes 29/11/11
[47] Field notes 22/11/11
[48] Field notes 14/09/11

tomatoes here to local retail sellers and to wholesalers from Manica, Chicamba and Bandula. Most tomatoes are transported here by a scotch cart or truck that lacks the necessary papers to enter the highway. Because of this, the particular traders and farmers cannot transport the tomatoes to Manica or Chimoio themselves. The quantities in which tomatoes are sold vary from entire boxes to basins and small buckets. Whether they are sorted or not depends on the particular farmer or trader. The market lacks any protection against the sun, but the nearby retail market does provide paid storage facilities for 15 Mts/month no matter the amount of boxes, which protect the tomatoes against insects and rain.

Urban wholesale markets

Regarding the urban wholesale markets, I will first discuss the activities that take place at the *Catanga* market in Chimoio. After that, I will briefly mention the particularities of the other wholesale markets in respectively Chimoio and Manica.

The Catanga market (Chimoio)

The '*Catanga*' or '*25 de Junho'* market is the main wholesale market for tomatoes in Chimoio and is located at the western side of the city centre. The market is occupied daily by wholesalers at the front side and some retail sellers at the back side of the market. Most of the wholesalers go to the field 2-3 times a week to buy their tomatoes from farmers at the field[49]. The majority of them provide inputs on credit to some farmers. Traders told me that there are farmers who come to *Catanga* to give their contact details and tell what inputs they need. However, I have not heard any farmer from the research area who does that. Some wholesalers also buy from farmers who transport the tomatoes to that market themselves. Several retail sellers who buy at *Catanga* told me that the price of one box of tomatoes sold by a wholesaler is always 50 Mts higher than that of a box sold by a farmer who came to *Catanga.* One wholesaler buying boxes from farmers at *Catanga* explained that you can get a small discount if you buy many boxes, because then you are able to negotiate.

The areas where traders buy tomatoes are not limited to the research area, but include a wide variety of districts[50]. I looked for a certain spread of those locations in time, but it seems that most traders have a particular area where they buy tomatoes during the main part of the year. In the rainy season though, scarcity of tomatoes and bad road conditions cause some traders to move out to more distant locations, such as Angonia in Tete province. Moreover, while tomato supply at *Catanga* is lower then, the demand is actually higher since more traders from Beira come to Chimoio in that period. The weather conditions in different seasons can temporally reverse tomato flows, e.g. in the dry season many traders from Chimoio buy tomatoes in Sussundenga, but during the rainy season some traders from Sussundenga come to Chimoio to buy tomatoes[51].

At *Catanga* market, wholesalers sell their tomatoes to sellers from the main retail markets in town, i.e. the '*Bazar central'* (central market), '*Mercado Feira'* and '*Trinta e oito'* market, and to sellers from the '*Bairros*', who sell in the various quarters of Chimoio. Most wholesalers sell both in large and small amounts, although those who trade many boxes during a week predominantly sell entire boxes whereas others sell a major part in 'basins' or 'gallons'[52]. Wholesalers do not sort the entire boxes they sell. The questionnaire results indicated that about 50% of the entire boxes traded at *Catanga* concern unsorted tomatoes[53]. Most tomatoes that are sold in gallons and other small amounts are sorted again though, both in size (big, medium and small) and in

[49] The fact that all market stands have plastic roofs to protect the tomatoes from the sun implies that mostly the tomatoes stay well for a couple of days.

[50] Frequently mentioned locations include: Zembe (near Chimoio), Sussundenga, Catandica, Rotanda, Iaque, Vanduzi, Macate, Makumbedze and Matsinhe.

[51] Even so, a trader from Beira told me that from Dec-April he buys tomatoes in Tete, but that in June-July he buys in Buzi and then tomatoes are actually transported from Beira to Tete.

[52] Most basins are about half the size of a box. Gallons refer to big tins or flacons of varying sizes, in which fit 1, 2, 3 or 5 kg of tomatoes.

[53] This value appeared both from the questionnaires with retail sellers from the *Bazar central* and *Trinta e oito* market who buy at *Catanga*, when asking for the quality of the tomatoes they bought.

colour (green and red). Some traders were also polishing the tomatoes they sold in gallons. The price of a gallon is relatively higher than that of a box, as during the period of daily price monitoring the average selling price of a box of 30 kg was 320 Mts, whereas a gallon of 3 kg cost 75 Mts. Here too the real price to be paid depends on negotiation, e.g. during one short interview I observed a wholesaler selling the same gallon for both 80 and 100 Mts.

The Trinta e oito market (Chimoio)

The *Trinta e oito* market located in a neighbourhood at the east side of Chimoio is another wholesale market, but for tomatoes it is of minor importance than *Catanga*[54]. Regarding tomatoes it concerns mainly a retail market, and most retail sellers from this market actually go to *Catanga* to buy their tomatoes, as for instance indicated by the following retail seller I interviewed at the *Trinta e oito* market.

> [BvdP]: Where do you buy your tomatoes?
> [Re]: I buy my tomatoes at *Catanga* during the whole year, because here the prices for a box are higher.[55]

Nevertheless, the *Trinta e oito* market also comprises some tomato wholesalers who buy from farmers that come there[56]. Regarding the higher prices, this could be an interesting opportunity for farmers from the research area as well. According to the traders I interviewed, there are no farmers from the Messica area who come to this market though, because it is located further away from the highway to Manica.

The Bairro 7 de Abril market (Manica)

The *Bairro 7 de Abril* market is the only wholesale market for tomatoes in the town of Manica. Like at the *Catanga* and *Trinta e oito* markets, there are also a considerable amount of retail sellers at this market. At the whole market there are only two wholesale traders, who buy from farmers who come to the market themselves, from the local wholesale market in Messica and from farmers at the farm-gate. Their practices concerning input provision, transport, type of customers and the quantities in which they sell are the same as for the wholesalers selling at *Catanga* in Chimoio. The price they sell for seems a bit lower[57], but since I never went to the market in Manica and Chimoio on the same day I am not sure of that. Their transport costs are about the same for wholesalers from Chimoio[58]. The two wholesalers trade respectively 25 and 90 boxes a week, whereas the average per wholesaler from *Catanga* is 24 boxes per week. One of them told me they also sort in big and small tomatoes, but I have not observed that.

Retail markets

Local retail markets

Retail markets for tomatoes and other vegetables can be found in several sizes in any community or neighbourhood. In Chirodzo and Ruaca itself, several women buy a box from any farmer with tomatoes, which they sort, eventually polish and then sell from a plastic on the ground. Those women are predominantly spouses of farmers that do not have access to irrigation. I noticed that prices here are exactly the same as on the retail markets in Messica. In Messica there is one major retail market and several small ones in the different parts of the village. The majority of the market sellers buy their tomatoes at the field, and like anywhere they prefer to buy big tomatoes that last long. They all sell about two boxes a week in piles of about

[54] For some other crops, like bananas, it is the main wholesale market in town though.
[55] Field notes 18/11/11
[56] The traders told me that many farmers who come to this market are from Macate, in the Gondola district situated east from Chimoio.
[57] At 27/10/11 the price of one box of big tomatoes was 200 Mts at the wholesale market in Manica. One week before the price at *Catanga* was 250 Mts/box, but this was the lowest price I had ever observed there.
[58] If wholesalers from Manica buy from the field, they use a truck from the field to Messica for 25 Mts/box and a truck from Messica to Manica for 20 Mts/box; whereas wholesale traders from Chimoio pay 45 Mts/box for one trip from the field to Chimoio.

4 tomatoes each, though at the major retail market the flow is slightly higher. Some tomato sellers also sell some cabbage, onions or bananas, but for most of them tomatoes are their most important product.

Urban retail markets

Both in Chimoio and in Manica there are many small retail markets and a few larger ones. The majority of the retailers buy their tomatoes at the wholesale markets, although especially during the rainy season a few traders practice a different strategy and go to the field themselves to buy directly from the farmers.

Generally, the smallest tomatoes are sold in the various neighbourhoods of the cities, whereas the biggest tomatoes are sold at the larger retail markets. At the two markets in the city centre of Chimoio, i.e. the *Bazar Central* and *Mercado Feira*, tomatoes and other vegetables are sold both in piles and plastics packages. The price for packed tomatoes is considerably higher, e.g. 5 lose big tomatoes cost 10 Mts whereas 7 packed ones cost 20 Mts. In Manica sellers do not make use of packages, as for instance explained by the following retail seller at the *Bazar Central* in Manica.

> [BvdP]: Are there no packed tomatoes sold at this market?
> [EC]: No, because they rot quickly then. We have tried it and saw it rotting.
> [BvdP]: In Chimoio most tomatoes are packed; why is it different here?
> [EC]: In Chimoio there are more customers. They pack it in plastic so that they can sell quickly. Here it takes a long time to sell, so we don't pack.
> [BvdP]: Did more people buy the tomatoes when you packed them?
> [EC]: No, in Manica that does not help.[59]

Indeed, the retail sellers in the centre of Chimoio seem to sell one box of tomatoes in less time than in Manica, even though they sell many vegetables whereas in Manica most sellers only sell one particular product[60]. Nevertheless, the fact that consumers in Manica do not prefer packed tomatoes whereas in Chimoio consumers are actually willing to pay a higher price for it indicates that the centre of Chimoio may host a different type of consumer. Other markets in Chimoio out of the city centre, e.g. the *Trinta e oito* market, did not show any packed vegetables either.

The market where most value is added to tomatoes concerns the only supermarket in Chimoio, which is a shop from the South African chain *Shoprite*. This definitely concerns again another type of consumer, since prices range up to more than tenfold the price at the other urban retail markets[61]. The purchase price paid by *Shoprite* is also considerably higher, for unpacked tomatoes about the double of the boxes sold at *Catanga* market. They have some fixed suppliers, but in the following quote the manager responsible for purchasing the vegetables of *Shoprite* explains that he buys from others as well.

> [BvdP]: Which suppliers get your preference?
> [AB]: If someone comes I do not refuse him. If the price and quality is good I will buy from them. In that case I just reduce the order of the fixed suppliers.[62]

The loose tomatoes at *Shoprite* come from traders who bought tomatoes nearby, including in the research area. The tomatoes they buy packed come from one big commercial farmer and from Zimbabwe. Those price conditions are even better; *Shoprite* pays them 35 Mts for 6 big tomatoes during the whole year, since there is only little competition. Nevertheless, although the high prices are very promising to any supplier, the fact that

[59] Field notes 27/10/11
[60] At the central markets in Chimoio and Manica they need respectively 1 and 1.5 week to sell 2-3 boxes of tomatoes.
[61] At 01/11/11, the cheapest tomatoes at *Shoprite* were 34 Mts/kg (about 10 tomatoes), whereas at *Bazar Central* they sold 7 equally sized tomatoes for 10 Mts. The price of packed tomatoes went up to 65 Mts for 6 big tomatoes or for one kg of medium-sized tomatoes.
[62] Field notes 01/11/11

they only need about 50 boxes a week implies that *Shoprite* is only a minor player on the overall tomato market in Chimoio, which has an estimated volume of about 650 boxes per week[63].

The value of tomato production

The tomato market provides a major part of the income for most farmers in the research area and for the various transporters and local and urban traders. Houses made of bricks or the possession of purchased objects like a bicycle or motorbike are all signs of increased wealth as a result of the area's tomato market development. The extremely short shelf-life of tomatoes that necessitates quick sales implies that the value of tomato production is almost purely monetary, as it cannot be stored for consumption. The monetary gains however differ considerably with respect to the timing of production and the location of selling. In table 1 I calculated the costs and profit of some important actors in the tomato value chain, based on the gains from one tomato cycle from August to November.

Table 1 Investment costs and generated profit per actor in the tomato value chain for a period of three months
The three-month period corresponds to the duration of one tomato cycle. The table is based on the average of daily prices of big and medium tomatoes in the period of Nov 26th to Dec 1st 2011. Those prices were used as a reference to calculate the turnover for a period of three months.

Actor	Investment costs (Mts)	Profit (Mts)	Profit/cost ratio
Model farmer producing only tomatoes without external labour, selling at the field (based on 0.25 ha with an input cost of 22,000 Mts/ha and a productivity of 16.7 Tons/ha[64]).	5,500	14,000	2.55
Model farmer producing only tomatoes without external labour, selling at *Catanga* (based on 0.25 ha with an input cost of 22,000 Mts/ha and a productivity of 16.7 Tons/ha).	11,000	23,000	2.09
Retail seller at the market in Messica buying from the field and selling 2.33 boxes per week[65].	4,300	3,700	0.86
Wholesale seller at *Catanga* buying from the field and selling 24 entire boxes per week.	60,000	41,000	0.68
Retail seller at *Bazar Central* in Chimoio buying at *Catanga* and selling 2.5 boxes a week in small plastic packages.	12,000	4,700	0.39

The table shows that a farmer who sells his tomatoes at the farm-gate makes considerably less profit than a farmer that would sell in Chimoio. However, I did not meet any farmer who actually does that in November. The wholesalers benefit from the highest income, whereas retail sellers earn the least amount of money. The

[63] At *Catanga* there are about 25 sellers with an average sales rate of 24 boxes per week. About another 50 boxes are directly transported from the field to the *Trinta e oito* market.
[64] The used input cost and productivity concern the average of data from 15 out of the 20 case study households. The area of 0.25 ha is the average cultivated area of farmers producing only tomatoes and without using external labour, not taking into account those farmers with extremely small cultivated areas that I will later classify as 'marginal farmers'.
[65] The sales rates concern the average of 11 sellers for the two retail markets and of 18 wholesale sellers for the *Catanga* market.

limited investment needed to buy and sell one box of tomatoes implies that it is relatively easy to start working as a retailer, whereas as a wholesaler one needs considerably more capital. Hence, the socio-economic position of the different market players differs considerably. Next to this the profit/cost ratio shows that farmers' investments are multiplied most whereas retail sellers in Chimoio only gain from a small profit margin. Nevertheless, farmers still face the highest risk because of both the high dependence of their profit on the weather and market price and due to the fact that the number of transactions by which they obtain their revenue is only limited compared to traders that buy and sell continuously.

The fact that I based the calculations on big and medium tomatoes only whereas on average 40% of farmers' production concerns small tomatoes for which prices can be considerably lower[66], implies that the actual profit will be a bit less. Nevertheless the same accounts for the various traders, who also indicated they can make most profit by selling big tomatoes. The profit I calculated for the wholesale traders is highly dependent on the actual number of boxes one sells. The table is based on the average of 24 boxes per week, but per trader this varies from 5 to 70 boxes. Furthermore, this table is based on selling entire boxes only, but most wholesalers sell part of their boxes in smaller amounts as well, for which they can get considerably more money. For instance, someone selling 5 boxes a week entirely in gallons would still have about 35,000 Mts profit in three months.

Some wholesale traders who sell relatively a lot in gallons buy most of their boxes from farmers that come to *Catanga*, which increases their purchase costs. For one wholesaler who buys and sells about 20 boxes per week at *Catanga* in both entire boxes and gallons, I calculated a profit of about 17,000 Mts per 3-month period. So, the wholesalers buying at the field seem to benefit from the highest profit margin. The retail sellers only make little profit, which is mainly because they only sell a few boxes in one week. This is also the most accessible income source, since anyone who has the capital to buy a gallon of tomatoes can sell those on one of the various retail markets.[67]

Due to the difference in the traded amount of boxes per actor, the profit per period does not show the value addition per box. In table 2 I showed the profit per box and the number of boxes sold by some important actors in the value chain.

Table 2 Profit per box and sales rate per actor in the tomato value chain
The table is based on model actors as described in table 1, and on the average of daily prices of big and medium tomatoes in the period of Nov 26th to Dec 1st 2011.

	Profit per box (Mts)	Number of boxes traded per week
Farmer selling from the farm-gate	100	11[68]
Farmer selling at *Catanga*	165	11
Retail seller at Messica market	120	1-4
Wholesaler at *Catanga*	130	5-70
Retail seller at *Bazar Central* in Chimoio	145	1-4

The table shows that a farmer who sells his tomatoes in Chimoio can gain from the highest profit of all actors in the value chain. Next to this, the urban retail sellers gain most per box, followed by the urban wholesalers and

[66] The price deduction for small tomatoes can vary from ¼ up to ¾ of the price of a box of big tomatoes.
[67] In order to sell at one of the main retail markets you need to be subscribed on a waiting list of the municipality though. This is not the case for selling in the various neighbourhoods, however there too sellers need to pay a daily fee to the municipality, ranging from 5 Mts/day for retail sellers in Messica and Manica to 10 Mts/day at the markets in the centre of Chimoio, which is collected daily by an official from the municipality.
[68] The model farmer produces 140 boxes on 0.25 ha in three months, which would imply 11 boxes per week in case the harvest would be equally spread over the complete production cycle. Nevertheless, due to differences in productivity this number would vary among the case study households from 3 to 30 boxes per week.

local retail sellers. The wholesalers show by far the highest sales rate, whereas retail sellers only sell few boxes. Since the price difference at the field and *Catanga* market is relatively stable throughout the year (see figure 8), it is especially the farmer who can benefit from higher box prices in different seasons. In figure 10 I depicted the value of a box of tomatoes within the main part of the market chain, and the value adding activities executed by each actor.

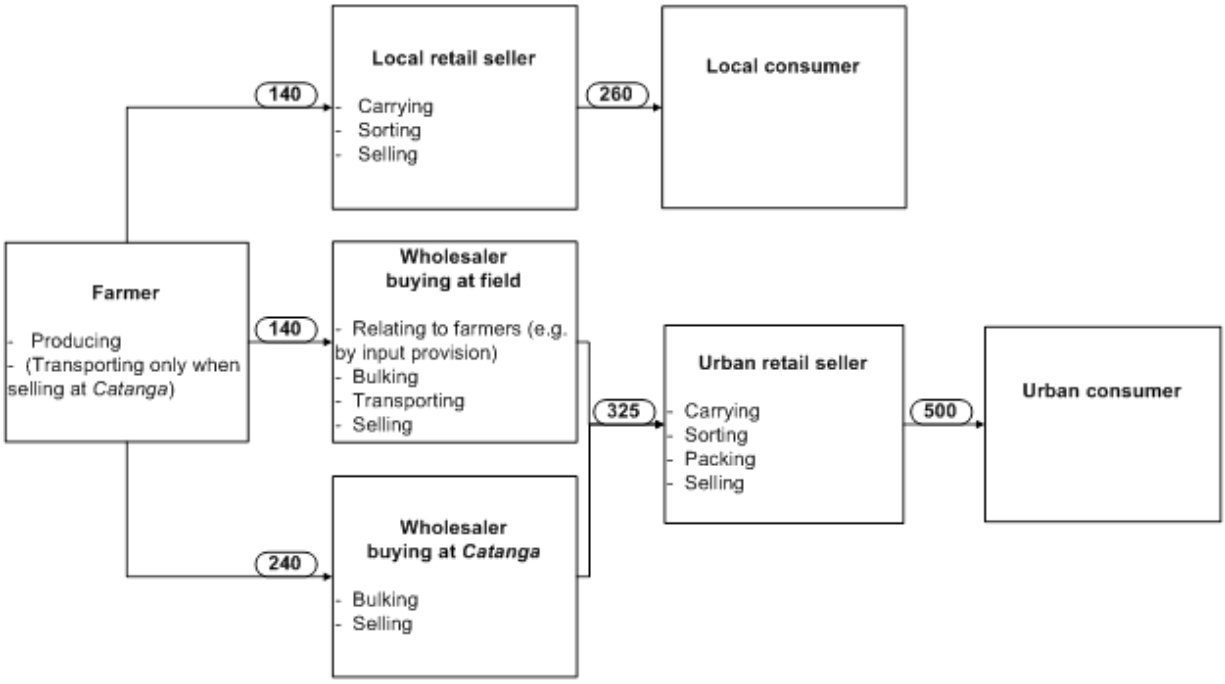

Figure 10 The price of one box or its equivalent of tomatoes throughout a major part of the value chain, and the value adding activities per actor

The data are based on daily price monitoring from Nov 26th to Dec 1st 2011. Since this has not been executed on all markets in the chain, this figure does not show all market opportunities that farmers make use of.

The figure shows that the tomato price highly differs among the different stages in the value chain. The main value adding activities on top of production are transport, sorting and selling, of which the latter is the most time consuming. Transporting tomatoes to Chimoio results in a higher profit, considering that the transport price is 50 Mts/box[69]. In late November, the transactions by farmers at the farm-gate or *Catanga* constitute respectively about 30 or 55 per cent of the price paid by urban consumers. This is already an important share, but in the rainy season this part will be even higher.

To conclude: tomato market opportunities

Farmers in the research area have massively responded to the tomato market development by increasing their tomato production. Prices obtained by farmers are highly variable on both an annual and daily scale. By selling unsorted tomatoes from the field in low price periods most farmers do not optimally benefit from the tomato market opportunities. Selling sorted tomatoes in Chimoio can almost double ones profit and focusing on production in the high price period can multiply this even more. Tomatoes are sold by means of a social transaction between a farmer and one of the many traders. Agreements on input credit and delayed payments are based on trust only. Though there is a sort of local day price that is strongly linked to the supply-based prices at *Catanga*, the exact price at field level depends on a negotiation between a farmer and trader on the harvest day. However, in the next chapter I will explain that the type of trader and agreements with respect to the term of collaboration a farmer engages in are mostly a matter of the farmer's particular business strategy.

[69] The transport cost is 45 Mts for a box of tomatoes and 5 Mts to bring back the empty boxes.

The value chain consists of various actors who execute different value adding activities. Wholesale traders usually buy tomatoes at the field and transport and sell them at a particular wholesale market. Retail sellers that buy from them carry the tomatoes to a retail market and sort and sell them in small amounts. At some urban retail market tomatoes are also packed in plastic. Prices at the end of November range from 140 Mts at the farm-gate to 325 Mts at the urban wholesale market and 500 Mts for the equivalent of one box sold at the urban retail market. Nevertheless the high sales rate of wholesalers implies that they make most profit, whereas retail sellers earn relatively little.

Hence, the research shows that in November farmers only receive a minor part of the overall value created within the tomato market. The majority of the farmers engage in vertical integration by making agreements with traders individually, whereas practically no horizontal integration takes place. By cooperating more farmers could become able to jointly fill up a truck and transport their products to a wholesale market in Chimoio. This would improve their position of limited price information and increase their share in the overall value of tomatoes that is created at the urban markets. In case of a low tomato price at *Catanga* it is even possible to drive directly to the *Trinta e oito* market where farmers from other districts already sell their tomatoes. Cooperation could also considerably reduce the purchase and transport costs when buying inputs.

4. Typology of business strategies

In this chapter I discuss the different business strategies that have evolved after market development in the research area. Like I explained in chapter 2, a farm typology can describe the diversity of farm units within a particular area. I will now explain how I developed a typology of the business strategies of the twenty case study households of this research[70]. Subsequently, I will discuss for each strategy how the particular farmers organise their production and marketing activities and how these interact within their overall business strategy. Lastly, I will compare the different strategy types and highlight the aspects in which they essentially differ.

As a first step I based the typology on the main indicators of commercialisation of a production system as established by Pingali (2001) like I explained in chapter 2. This included the farmers' objectives, input sources, product mix and household income sources. Because of the major role of tomato production in the area and its high price variability I added to this the timing of the tomato production. Based on this I found five different strategies and I labelled the farmers as diversified farmers, intensive tomato producers, land renting tomato producers, innovators and marginal farmers (see table 3). Subsequently I compared the individual farmers in those groups on their marketing, water use and labour characteristics. It was interesting to notice that farmers with similar production features also showed the same marketing characteristics. In the description of the different strategy types I will explain why I consider this as a logic consequence of their production or business strategies. I added the marketing features to the typology of business strategies in table 3.

Table 3 Typology of business strategies
Vertically the table shows the different types of business strategies and horizontally it depicts the particular production and marketing characteristics.

	Objective	Input use	Product mix	Other income sources	Timing tomato production	Marketing
Diversified farmers	Consumption and sales with spread risks	Very low	Diverse	Yes	Off-season	Different customers
Intensive tomato producers	Year-round high tomato productivity	Very high	Tomatoes	No	Year-round	Fixed customers
Land renting tomato producers	Income generation during the dry season	Medium	Tomatoes	No	Peak season	One customer per field
Innovators	Searching best market opportunities	Low	Diverse	No	Off-season	Selling in town
Marginal farmers	Subsistence and small-scale sales	Medium to very low	Rain-fed and garden	Yes	Money-dependent	Selling small amounts to different customers

[70] I left one farmer out of the typology; since he forms an exceptional case. It concerns a shop owner who seems to be in transition from a marginal farmer to an intensive tomato producer since his main field was connected to a canal earlier this year. However, since this process has only started recently I do not have insight yet in his crop planning for the rest of the year, the amount of inputs he will use, the customers he is going to sell to, and the fact whether he is able to structurally maintain this strategy. Hence, I could not yet assess the objective and realisation of his new business strategy.

I also discovered that farmers with similar production and marketing strategies had considerable differences in their water availability and labour organisation. This is interesting since for many African farmers those are important differentiating factors (Green et al., 2006). In chapter 5.4 and 6 I will show why this is different for the farmers in the Messica area.

Since the strategy types are based on a variety of indicators that cannot be expressed in an ordinal scale, the sequence in which the different types are discussed does not imply any ranking either. I will start with the diversified farmers, who have basically maintained the diverse product mix that was common before the process of market development started. The only essential difference is that they have expanded their cultivated area and adapted their crop calendar to the market. Many other farmers adopted another strategy and chose to focus on tomato production. The intensive tomato producers produce year-round high tomato yields for fixed customers. The land renting tomato producers chose for the same focus, but their lack of privately owned irrigable land forces them to produce in the peak season only. The fourth strategy I will discuss concerns the innovators, which is a small group of farmers who search for innovative ways to realise a particular product mix, timing and marketing approach, in order to make use of the best market opportunities. Finally, the marginal farmers are the people who structurally do not manage to produce sufficient to make a living out of agriculture alone.

4.1 Diversified farmers

The three diversified farmers within the 20 case study households cultivate many crops for both consumption and sales. They have adopted a risk-averse strategy of spending little on inputs and being close to self-sufficient. The next quote for instance shows a diversified farmer who does not want to spend money on labour.

> [BvdP]: Is it possible for you to have a bigger field?
> [JC]: This field is enough for me, because for a big field I would need workers, and I do not have money to pay them.[71]

In fact this strategy is not a matter of limited capital, since two of the farmers possess respectively 7 and 11 cows[72]. One of them is also building a second house in Messica. Their family situations are pretty diverse[73]. All of them have some additional income sources, such as making pottery, cow trading, fruit trees or a small shop. All farmers in this group faced some major disturbances with major implications for their production[74]. Because of this, two farmers irrigated during the period of fieldwork only 0.04 and 0.06 ha respectively instead of the 0.4 ha that they irrigated before. I will use the way those farmers produced before rather than their production in this particular year to discuss their business strategies, since none of them seems to be structurally affected by the particular shock events.

The farmers in this group all grow a variety of crops that are quite common in the area, like tomatoes, beans, cabbage, onions and okra. Next to that some grow yam or rice on naturally wet fields, or maize for sales in the rainy season. Their input use is low for all crops, including for the tomatoes. Two of them use manure only, respectively raw and treated. When I asked about his fertiliser use one diversified farmer explained why he had switched to manure.

> [JC]: I use manure now because of the money. My harvest was bigger when I was using fertiliser.
> [BvdP]: If you take into account the costs of fertiliser, did you in the end also make more money at the time?

[71] Field notes 06/10/11
[72] The third farmer buys and sells cows throughout the year, but his current stock is unknown.
[73] One is a married young farmer who started four years ago, another one is a middle-aged widow with both young children and older children that already moved out. The third one is an old man with many children of which three still live at home.
[74] The young farmer's father died, the widow's crops were eaten by cows and the older farmer was ill for a long time.

> [JC]: If you use fertiliser you get more harvest but you earn less due to the higher costs. I earn more when I use manure.[75]

The third farmer does apply fertiliser when he has money, and otherwise manure. With respect to pesticide use on tomatoes the two values I obtained are pretty different (see figure 19 in attachment A), probably due to over-application on a very small field. Some apply pesticides on their beans and cabbage as well. The tomato productivity of about 5.5 tons/ha on last year's big field is pretty low for both farmers, and so is the profit of 70,000 Mts/ha of a field harvested just before the peak harvest period.

All diversified farmers use only their own land. Two of them cultivate cash crops during the whole year. A third one also produces maize on her horticultural field, which she strategically plants early. This enables her both to sell maize in the period when people start to have shortages and to produce two tomato harvests just before the price drop in October and November, like she explains below.

> [BvdP]: Why do you start your vegetable production early?
> [JK]: Because then most farmers do not plant yet because they are still working on the maize fields. Therefore there are only few tomatoes then and so I can sell for a higher price.[76]

The other two farmers also plant their tomatoes off-season, respectively in November and in December and February. Hence, the timing of their tomato production is market oriented. The three farmers all sell their tomatoes to customers from Messica or Chimoio that come to their farm. They do not contact traders by phone but they make an appointment to traders that pass by. Of all their other crops they also sell the biggest part. The two farmers without a scotch cart prefer to sell from the farm, however the farmer who does have one has a particular market for each crop[77]. Two farmers rent a truck to sell their maize to a company in Chimoio. One told me that this is not possible for tomatoes, since it takes too long to sell them.

The diversified farmers illustrate a strategy that is both commercial and risk averse. They minimise risk by their low input use, multiple income sources, cultivation of common crops and high self-sufficiency. The tomato productivity is low, but due to the off-seasonal timing they can benefit from high prices.

4.2 Intensive tomato producers

The three farmers I classified as intensive tomato producers maintain a pretty different strategy than the diversified farmers. Their objective is to produce as many tomatoes of good quality as possible throughout the year. All of them are families with young children and no other income sources. Their number of cows is a bit above the average. Two of the farmers have built themselves a pretty large house compared to the other farmers in the area, which indicates that they are doing well. The different farmers cultivate an irrigated area from 0.2 to 0.5 ha. For two of them tomato is basically their only irrigated crop. The third one cultivates about equal areas of tomato and cabbage. Next to that, all of them cultivate maize for sales in the rainy season, on top of the amount needed for consumption.

With an average phosphate and ammonium-nitrogen application of respectively 540 and 230 kg/ha; they all apply relatively much phosphate (see figure 18 in Appendix A). Their pesticide use is even more intensive, since with an average expenditure of 20,000 Mts/ha they spend about twice as much as the average of all case study households (see figure 19 in Appendix A). Their high pesticides cost is not only due to their high number of applications, but also to the fact that they apply 3, 4 and 6 different pesticide products, whereas most other farmers only apply 2 products. The input use clearly differentiates farmers using the strategy of intensive tomato production from the other farmers.

[75] Field notes 06/10/11
[76] Field notes 22/11/11
[77] He sells fruit, beans and cabbage in Messica, onions and rice in Manica and maize in Chimoio.

[BvdP]: Why do you use more products than other farmers?
[KZ]: I use many products to prevent that my crops are attacked by insects and diseases, so that I get more harvest. Other farmers do not put enough pesticides on their tomatoes. It's better to spend more and to harvest more than to spend less and harvest less.[78]

Two farmers explained me that their pesticide use accounts for the quantity of their harvest, and one added that the fertiliser determines the quality. The third farmer could not explain this, but said it is because of the combination of all inputs. When I compared their productivity to that of other farmers, I noticed that indeed they produce more; 32 and 26 tons/ha compared to the average of 17 tons/ha (see figure 20 in Appendix A). Regarding the quality, one farmer had 73 per cent of his tomatoes big or medium sized compared to an average of 61 per cent, however this is based on sales data from 6 farmers only.

The intensive tomato producers do not produce in a specific period, but basically year-round. Nevertheless, they strategically plant more fields right before and after the peak season than within this period, which also indicates that they keep an eye on the market. From the five farmers of which I could calculate the total profit per ha, i.e. the costs of inputs and paid labour deducted from their revenue, the two intensive producers generated the highest profit; respectively 314,000 and 167,000 Mts/ha. This profit was obtained off season, in the peak season the profit would be significantly lower.

All farmers within this type have one or more fixed customers to whom they sell during the whole year. I consider this a direct consequence of their year-round production. In this way, farmers can agree with customers that they also buy from them in the peak production period, whereas the customers have a guarantee on tomatoes when only a small quantity is being harvested in the area. This is illustrated by a quote from an intensive producer who strategically sells tomatoes regularly to each trader from his customer file.

[BvdP]: Why is it good for yourself that you regularly sell tomatoes to all your customers?
[TC]: Because I do not have guaranteed customers and in this way they are all happy. If there are a lot of tomatoes in the area they will also buy from me because they know I am a good man.[79]

The agreements and trust between the farmers and their fixed customers differ a lot per individual case though. Whereas the above quoted farmer has fixed customers from several towns of whom he chooses the one with the highest price at that moment; another farmer has just one customer that refuses to pay the price on which they agreed. The third farmer is linked to one customer that paid for his inputs, but he also sells to other traders. His customer sells to a supermarket, and according to the farmer it is because of the good quality of his tomatoes that she buys from him. Since their way of producing is similar, the difference in marketing conditions among the three farmers is probably a matter of personal marketing skills rather than their production.

In short, the intensive tomato producers are specialised farmers who invest a lot and benefit from high yields and good quality tomatoes. They produce tomatoes year-round and as result they can sell to fixed customers. However, the ability to benefit from those agreements differs among the individual farmers.

4.3 Land renting tomato producers

The main difference of the three land renting tomato producers from the intensive tomato producers is that they use the fields of other farmers for their irrigated production[80]. They share a focus on tomato production, though some of them also cultivate a bit of cabbage or some onions. They are all relatively young farmers with young children. Two of them are in their twenties and started producing tomatoes this year; the third one is 36

[7878] Field notes 18/10/11
[79] Field notes 13/10/11
[80] One uses his father's field, another one the field from a friend and a third one uses both his own field and a field of 0.5 ha that he rents for 600 Mts per season from his aunt.

years and already produces for a long time. All of them still have young children and no other income sources. They possess zero, one and two cows. I did not observe any indicators of increased wealth, except for the older farmer's broken car. In the peak season they cultivate 0.3; 0.4 and 0.8 ha of irrigated area.

The fact that the land renting tomato producers use the irrigated land of other people is directly linked to the timing of their production. They are forced to produce in the peak production season since they have to give back the fields to the owners for the production of maize in the rainy season[81]. As a result, they cannot benefit from higher prices. On top of that, one of them does not have the land to produce a surplus of maize either.

The land renting tomato producers indicated that they view tomatoes as the crop with which they can make most money in the hot season, even considering the possibility of bad harvests and low prices.

> [BvdP]: Why did you choose to grow tomatoes?
> [JS]: I get more profit from tomatoes, even if something fails.[82]

Contrary to the first two categories, farmers of this strategy type apply equal amounts of phosphate and ammonium-nitrogen; all use about 320 kg/ha. Therefore, their phosphate and ammonium-nitrogen use is respectively below and above the average (see figure 18 in Appendix A). None of them uses any manure. They all spend near 5,200 Mts/ha on pesticides, which is relatively low (see figure 19 in Appendix A). For the older farmer it is his strategy to plant less plants per ha and give space to the plants. This resulted in a relatively low yield of 12 tons/ha though[83]. From the other farmers, one received his inputs from his customer and the other one bought it himself. Those farmers do not apply the low density strategy, since they actually used a lot of seed per ha.

Their forced short production season implies that land renting tomato producers cannot sell to fixed traders throughout the year, but rather sell to one trader per harvest period. Two farmers were not satisfied with their customer in the first period and will look for another one for their next field. The other farmer does sell to the same customer, because he sells to the fixed customer of his neighbour who produces during the whole year. The land renting tomato producers are more prone to bad behaviour of traders, since their negotiation position is less strong in the peak production season.

With their choice to focus on tomatoes during the short time in which their irrigated fields are available, the land renting tomato producers do not have much choice regarding the timing and marketing of their tomatoes. Their relatively low pesticide use may actually be an opportune way to deal with the low tomato prices, however the high ammonium-nitrogen use is not. Since two of the farmers just started, this inconsistent input use may be due to a lack of experience.

4.4 Innovators

The four farmers I characterised as innovators seem to be constantly looking for the best market opportunities. Their socio-economic conditions are highly diverse and range from one single young man with no children and two cows to an old man with one wife, thirteen children and twenty-two cows. The young man only started a few years ago, but the other three all show indicators of increased wealth, such as big houses and a motorbike. None of them has additional income sources next to their farming activities. Their farming systems consist of various crops that are predominantly destined for sales. Though the size of their irrigated area ranges among the different farmers in July from 0.2 to 1.4 ha and in November from 0.2 to 2.8 ha, their way of producing and their arguments for doing so are of the same character.

[81] The farmer that also owns a field himself produces some tomatoes beyond the peak season as well.
[82] Field notes 25/11/11
[83] One of the two young farmers actually generated the highest productivity I observed; 47 tons/ha. However, this is probably because it concerns a new field that had never been used for irrigated production before.

The innovators all apply a diverse product mix. Each of them cultivates common crops like tomatoes, cabbage and beans, but next to this they grow or are planning to grow crops that are less prevalent in the area. One of them grows tobacco and green pepper, another one wheat, garlic, carrots, cucumber and green pepper and a third one wants to start experimenting with potatoes next year. A fourth farmer, who does actually focus pretty much on tomatoes during the dry season, seems to be more innovative during the rainy season, when he cultivates considerable areas of a sesame-like crop called *giri giri*. Their maize production in the rainy season is only for their own consumption.

The input use on their tomato fields is relatively low compared to the other farmers. On average they apply 350 kg of phosphate and 190 kg of ammonium-nitrogen per ha, which is slightly below the average of all farmers (see figure 18 in Appendix A). The graph shows some spread within this group, but this is mostly because one farmer uses relatively more phosphate and less ammonium-nitrogen. Regarding pesticide use, all innovators spend approximately 3,600 Mts/ha, which is only about one third of the average in the area (see figure 19 in Appendix A). For the other irrigated crops they also use fertiliser, manure or both, provided that they have cows near their house. On most of their other crops they use pesticides as well; though less products than on their tomatoes.

Of the two farmers who had already harvested their tomatoes, one showed a medium productivity of 17 tons/ha and one a very low productivity of 5 tons/ha. This implies that the strategy of low input use can generate differing results. However, their low productivity may also be the result of timing (see figure 21 in Appendix A). The two farmers planted their tomatoes in February and July; which could cause problems due to respectively rain destroying small plants and high temperatures speeding up the maturation of tomatoes. The next quote concerns the president of the union who explained the reason for his low harvest, which corresponded to what many other farmers had told me.

> [Ma]: In summer the yields are lower due to the sun.[84]

The following quote is from my translator, who is also a tomato farmer in the area and explained me why only few people produce in the rainy season.

> [DM]: It's not easy to grow tomatoes in the rainy season. It's hard to make seeds grow on the seedbed, because the rain makes the soil heavy and the plants cannot get through it. Next to that, the water washes out the pesticides.[85]

Despite the lower yields most innovators actually benefit from the strategic timing of their tomato production. Figure 21 shows that productivity may decrease by fifty per cent, but as explained in chapter 3, prices can increase ten-fold. Three innovators plant their tomatoes explicitly off-season to benefit from higher prices. The fourth farmer, who plants in July, does produce in the peak production season. However, this is because he needs all his labour in the rain season for his *giri giri* production. In the following quote an innovator explains how he deals with tomato production in the rainy season.

> [BvdP]: Do you always grow your tomatoes in the rainy season?
> [JK]: I prefer tomatoes in the rainy season, because then there is a higher price.
> [BvdP]: Do you not have problems with the wet soil?
> [JK]: If it's too wet the tomatoes can rot, so I put sticks at the plants to keep them up.[86]

[84] Field notes 01/12/11
[85] Field notes 04/10/11
[86] Field notes 25/10/11

This example shows that the innovators are not only innovative with respect to their product choice and timing; but also in overcoming practical problems. To deal with shortages of water and especially labour necessary for irrigating; one farmer installed sprinkler irrigation and another one is planning to do so. Two farmers dug their own canal and a third one rehabilitated one. One farmer is also organising his neighbours to do big jobs like weeding a maize field together. In this way they use their skills to be able to continue where other farmers face a constraint.

With respect to the marketing of their tomatoes, the innovators do not only benefit from price variability in time, but also from price variations within the value chain. They explained to me that especially in the high price season, it is more beneficial to transport the tomatoes to towns like Chimoio or Beira yourself rather than selling them to customers that buy from the farm-gate. Therefore, one of the innovators has his own truck and two others rent one when necessary. The fourth farmer, who still sells from his field, bought a truck in Zimbabwe for the same reason, but he has problems to import it. If they do not have enough tomatoes, they fill up the truck with other crops or they share it with other farmers. Hence, for using this marketing strategy it is not required to produce an extremely large amount of tomatoes.

In short, innovators gain from the timing of their production and their marketing practices, and save costs on their input use. Their arguments for the timing of the tomato production and their choice for less common cash crops in the peak tomato production season indicate that the innovators have a market-oriented production. The fact that they link their production decisions to the market actually shows that they think in a complete business strategy, rather than just in production.

4.5 Marginal farmers

The six farmers I classified as marginal cover a wide variety of households that throughout the years have not managed to produce a considerable plot of cash crops. Underlying reasons include a lack of money, labour or access to water. The money they earn with their rain-fed products or small irrigated crops is used for daily consumption only, and so they do not manage to increase their capital with this. Therefore, the marginal farmers have mostly a strategy of subsistence. They cover all age categories and have different numbers of children. Three farmers cultivate 0.14, 0.08 and 0.02 ha of irrigated area. The other three do not irrigate at all. All of them have additional income sources such as selling tomatoes, working for other farmers or burning trees for charcoal production. However, they indicate that with those jobs they earn less than with irrigated agriculture. At the moment most of them still possess cows, but those are an indicator of their past rather than their current success[87].

Two farmers still focus their irrigated production on tomatoes, the third one produces many crops on one field. The other farmers only produce rain-fed crops like maize, sorghum or *giri giri* and some men have a small garden near a river to produce fruit, yam or pumpkin leaves. Three marginal farmers do not manage to produce a surplus of maize during the rainy season[88].

With respect to tomato production, two farmers use fertiliser. For both of them their phosphate use of about 220 kg/ha is relatively low, whereas their ammonium-nitrogen use is respectively equal to and below the average (see figure 18 in Appendix X). Two farmers have a medium pesticide expenditure of 7,000 Mts/ha, whereas one applies relatively much (see figure 19 in Appendix X). The yields of the farmers with medium

[87] They have respectively 7, 4, 3, 3, 2 and 0 cows. The one with 7 cows has worked for an HIV education programme, the ones with 4, 3 and 2 cows are older people who have built up capital in the past. One farmer with 3 cows had used all his money to buy a cow three years ago, and as a consequence he still does not have enough money to buy new inputs.

[88] One is constraint by not having cows and another farmer has a limited labour capacity due to his age. The third one lacks the land to cultivate more maize.

pesticide use were relatively low[89]. Some farmers also apply pesticides on their cabbage and *giri giri*. Most farmers do not use fertiliser on their other crops, but just manure[90].

The timing of the tomato production varies among the different farmers, most plant some tomatoes both within and beyond the peak production season. The timing of their production seems to depend mostly on their available money for inputs. Some farmers who planted anyways faced damaged harvests since they could not buy pesticides. The following quote of a marginal farmer shows one of the many occasions in which she explained that a certain aspect of her production system is caused by a lack of money, and that she first has to work as a temporary worker for other farmers in order to collect the money.

> [BvdP]: Why did you not plant your tomatoes in one time?
> [MC]: To reduce the workload and to have time to look for money to buy inputs.
> [BvdP]: If you had the money, would you then plant them all at the same time?
> [MC]: Yes then I would plant in one time. I will manage to get the work done together with my son and his wife.[91]

Regarding the marketing of their tomatoes, they all sell from their farm, each week to different customers. This is partly a consequence of their small fields, since customers are not interested in making appointments with farmers that can only sell a few boxes. However, for the farmers it is also not necessary, since it is not hard to sell a few boxes. Due to their small production, marginal farmers sell mostly to customers from Messica. However, if they encounter some customer from the city on their harvest day, they can also sell to them. For the other crops there are few customers present in the area, so the farmers bring them to the market in Messica[92]. Most of them sell all their products at once to a trader, but some farmers also sell part of their products in small amounts. The ones that can sell maize do this to people living around.
Summarising, the marginal farmers are those who have structural problems to make money with agriculture and to build up capital. They need the profit from their farm and additional income sources for consumption, and are not able to invest in cows, a house or their farming system. Everyone has his particular product mix, with differing emphasis on consumption or sales. The timing of tomato production is mostly money-dependent. Furthermore, their small plots do not allow them to engage in other marketing strategies than random or small-scale sales.

4.6 Comparison of the different strategies

I will now briefly compare the five different business strategies. It is hard to say which strategies are the extremes that share the least similarities. The innovators and intensive tomato producers seem to be the two most commercially oriented farmers because they produce for sales during the whole year and consume only a small part of their production. However, the production strategies in which their market views are translated can be considered as the most different of all strategies. I will now briefly compare the different business strategies and show how the particular production and marketing aspects are linked.

The two strategies that look most similar at first sight are those of the innovators and diversified farmers. Both production strategies are characterised by a diverse product mix, low input use and off-season tomato production. The main difference with respect to production is that the innovators constantly look for less common crops with high values, whereas the diversified farmers grow traditionally common crops. Next to this the innovators use fertiliser whereas the diversified farmers hardly do so. The difference in crop choice is the result of the innovators' attitude to continuously look for the best market opportunities. The particular marketing strategies of both farmer types show the difference between them most clearly. The innovators

[89] The farmer not using fertiliser produces 1 ton/ha. The other one produces 15 ton per measured ha, however if corrected for the high slope this will be considerably lower.
[90] Except for one farmer who applies fertiliser on his okra.
[91] Field notes 04/10/11
[92] Except for the farmer producing *giri giri*, who sells to a company that picks it up at his farm.

benefit most from their harvest in the peak tomato price period, since they rent a truck to sell in town. The diversified farmers rather sell their tomatoes to any customer that comes to their field. The fact that the diversified farmers have lower yields and thus need more effort to fill up a truck shows that this is partly a result of their production system. In chapter 5 though, I will explain that the different logics that characterise both business strategies form the essential cause for the differences in both their production and marketing strategies.

Two other strategies that seem relatively alike are those of the intensive tomato producers and land renting tomato producers. Both focus their entire irrigated production on tomatoes, use fertiliser and pesticides and sell their whole harvest from a field to one single customer. The main difference is that the land renting producers cannot produce beyond the peak production season since they do not have their own irrigable fields. The intensive producers on the other hand can harvest tomatoes during the whole year. The mutual benefit of year-round tomato delivery for farmer and customer is the reason why the intensive producers can agree with a customer to sell to him/her during the whole year, whereas the land renting producers have to look for a new customer every harvest period. Another production aspect that contributes to this is the fact that the tomatoes of intensive producers are of a higher quality due to the elevated input use by those farmers. Intensive producers are not able to sell their tomatoes in the cities due to their agreements with customers.

The marginal farmers, i.e. those farmers with structural problems to make a living with agriculture, show the biggest diversity of production strategies. Strictly speaking, they cannot really be characterised as one particular strategy. Within the marginal farmers there are actually farmers that apply parts of the other four strategies, although to a lesser extent. Some of them have a rather diversified farm with many crops. Others focus on tomato production like the intensive and land renting tomato producers. Another farmer has a more innovative approach, as he constructed an irrigated system and grows *giri giri* for a company. Their limited production however, forces all of them to adopt the same marketing practices; i.e. selling tomatoes from the farm-gate and carrying other crops to Messica.

This chapter showed that market development in the area has led to different business strategies among farmers. One is not necessarily better than the other; although farmers within the innovators, intensive tomato producers and diversified strategies seem to be less constraint in the development of their farming system than the land renting tomato producers and especially the marginal farmers. The different logics of the five business strategies are reflected in both their production and marketing activities. Moreover I showed that production and marketing decisions have an impact on each other as well.

5. The factors behind strategy differentiation

The previous chapters showed that in about one decade farmers have developed different business strategies as a response to the arrival of tomato traders to the area. In this chapter I will show that the different strategies can be characterised by underlying patterns that have determined farmers' decisions to engage in a certain strategy. I will explain that differentiation has both arisen as a consequence of particular capacities and different logics on which farmers base their strategy. Investment capacity is a crucial factor that explains the strategy differentiation, and that this does not depend on one's initial financial resources but rather on farmers' specific skills to build this up. Furthermore, next to such skills one's financial capacity and willingness to invest also result from different logics with respect to risk management that characterise the different business strategies. A distinct capacity that sets the innovators apart from the other farmers concerns their innovation capacity, which is a matter of both their financial capacity and other specific skills to identify and use opportunities. Next to this I assessed the role of the organisation of labour, but I concluded that the characteristics of the research area imply that this does not play a main role in determining farmer's cultivated area and business strategy.

In box 2 and 3, I will first show the logic behind the complete business of two case study farmers. The type of data concerning their livelihoods also provides an idea about the information I could draw on to understand the businesses of the other case study households. Following, I will discuss the role of farmers' investment capacity and continue by explaining the particular impact of innovation capacity. After that, I will discuss the role of risks and resilience and finish with an explanation of the organisation of labour in the research area.

Box 2: Mr Jose Camba – characterised as a diversified farmer

Mr Jose Camba is 45 years old. He lives with his wife and three sons on his farm in upstream Chirodzo; his three daughters have been married and moved out. Two sons still go to school and the third one owns a small shop in Ruaca. When his son works at the field Mr Camba occupies the shop and vice versa. His wife does the housekeeping and helps on the farm. Mr Camba owns 11 cows, and whenever he earns a lot of money he buys one more. He does not have a phone, but his son does. Next to his house he has three irrigated fields, two maize fields and a rice field, and a few km away he has another maize field.

Mr Camba and his family moved to their current farm about 15 years ago. In the beginning they only produced rain-fed crops. A few years later, in 1998, one upstream farmer constructed an intake and canal to irrigate, and right after that Mr Camba and his neighbour asked him for permission to lengthen the canal up to their fields. In the years that followed, Mr Camba expanded his irrigated fields. In the last couple of years he used to irrigate 0.4 ha, but since he had been ill and spent his money on the doctor and medicines, during the year of fieldwork he only irrigated a small field for his own consumption.

In the rainy season, Mr Camba cultivates two cycles of irrigated beans and tomatoes on 0.4 ha. He sells the tomatoes to a trader at the farm-gate, but sells the beans himself in small amounts at the market in Messica, which takes him about two weeks. Next to that he produces rain-fed maize for both consumption and sales. He rents a truck to sell the maize to the Semoc company in Chimoio, each year about 40-50 bags. Furthermore, Mr Camba is the only farmer I met who also cultivates rice. In two of the last five years he managed to cultivate a large rain-fed rice field of 0.8 ha because of the high rainfall. In the other three years he only cultivated rice on a small wet place on the stream bank. In the dry season Mr Camba cultivates and irrigates an unknown area of cabbage and 0.2 ha of onions. He sells the cabbages also at the market in Messica, but he takes his onions to Manica by minibus because he can get a better price there. Next to that he has 13 irrigated fruit trees planted in 1995, and another 8 trees planted in 2010. He sells the mangos, avocados and litchis at the market in Messica. Next to that he has a vegetable garden for his own consumption of about 0.06 ha. He hardly needs to buy any food; he only buys things like salt and cooking oil.

Mr Camba also owns a lot of land he does not cultivate, because he does not want to spend more money on workers. This accounts both for his irrigated and rain-fed production. Apart from weeding the tomatoes and maize, he does all the work with his sons and wife. He does not use fertiliser either, because he said he makes more profit by saving on fertiliser costs and using manure instead. His cows graze nearby, and he can use his scotch cart to transport the manure. He does use two types of pesticide on his cabbage, beans and tomatoes, but since he only cultivated a very small field this year I could not assess whether he applied a lot or not. His tomato productivity is very low, last year he only harvested 5 tons/ha, whereas the average of the case study households is 17 tons/ha. Each harvest period Mr Camba sells to a different trader, that he starts looking for just before the first harvest week.

Box 3: Mr Ken Zondai – characterised as an intensive tomato producer

Mr Ken Zondai is 37 years old and lives on his farm in upstream Chirodzo with his two wives and five children. Two of his children go to school, and since the oldest child is only 9 years old they do not help on the farm yet. Mr Zondai owns 2 irrigable fields and 6 rain-fed maize fields on several locations within a radius of about 2 km. One of the irrigable fields had just been bought during the period of fieldwork. At the moment of fieldwork, nor him nor his wives had additional income sources beyond their tomato and maize production. Mr Zondai's wives take care of domestic jobs and occasionally they produce some onions or cabbage for consumption. Next to this they help him on the field, e.g. when irrigating, transplanting and weeding the tomato fields and when seeding, weeding and harvesting maize. Only when planting a big field of tomatoes at once he employs 2-3 workers for a day, and probably he also uses day workers for weeding his maize fields.

Mr Zondai used to produce tomatoes and onions until four years ago, when he stopped producing irrigated cash crops because of the low price he received for his tomatoes. During four years he focused on rain-fed maize production, and the construction and sales of timber and furniture. In January 2011, i.e. 8 months before the period of fieldwork, he started to produce tomatoes again since he had seen other farmers making good money with it. He explained that as a farmer he earns more than as a carpenter.

He restarted his tomato production on two irrigable fields from another farmer that are situated within a different irrigation system than his own fields. The owner is a friend of him who let Mr Zondai use the field for free, provided that he would clear the field from bushes before starting and give it back during the rainy season. From January onwards Mr Zondai planted tomatoes each month, and in October he will continue doing so on his own irrigable fields. He did not plant any other crops on his irrigated fields. He sells his tomatoes to one wholesaler from Chimoio during the whole year, whom he met in the beginning of the year when she was buying tomatoes elsewhere in the area. He does not want to rent a truck to sell in Chimoio, because he thinks the traders will pay a lower price there.

Mr Zondai argues that other farmers do not use enough inputs. He uses more inputs because he wants to harvest big tomatoes for a longer time span than other farmers. Per hectare of tomatoes Mr Zondai applies 550 kg of phosphate and 180 kg of ammonium-nitrogen, which is respectively much more and a bit less than the average of the case study households. Furthermore he spends 16,200 Mts/ha on 6 types of pesticides, whereas the average is 9,500 Mts/ha. He mainly uses the revenue of his tomatoes to buy new inputs, pay temporary workers and build a big stone house. Mr Zondai owns 6 cows, and 4 of them have been bought by the income from his tomato production in the past. Regarding his maize production, Mr Zondai sells about 80 bags of the 100 bags he harvests. He buys part of the seed he uses, which is exceptional as most farmers use their own seed only. Further he only uses manure on his maize fields, which he transports there with his own scotch cart.

In short, at the moment Mr Zondai considers year-round intensive tomato production as the most profitable option in addition to the risk-reducing cultivation of a considerable maize surplus, and therefore he focuses his strategy on those two production systems. A continuous reinvestment of money in new inputs allows for the capital-intensive logic that characterises his strategy.

5.1 Investment capacity

Any farmer who is asked for the main constraint in his production system answers that a lack of money keeps him from cultivating a big field. After assessing their complete farming systems, it appeared that indeed a lack of money to buy inputs constrained 15 case study households to expand their cultivated area. Though their need for money is shared by all farmers, considerable differences exist with respect to their cultivated areas and investment in inputs and other productive assets.

In chapter 4 I showed that one young farmer with little capital managed to adopt an innovator strategy, whereas I classified two other young farmers as a land renting tomato producer and a marginal farmer. This is because investment capacity is not only a matter of financial resources. Investment capacity is created by decisions with respect to the use of one's income. Consumption, direct re-investment and different forms of savings result in different capacities to invest in one's production system. Each form of money use requires particular skills, e.g. to get an overview of the costs and gains of particular investments or to inform oneself about credit sources and saving possibilities. This combination of assets implies that each farmer has a particular capacity to invest in his farming system.

In this chapter I will discuss the role of farmers' investment capacity in the development of the different business strategies as described in chapter 4. I will first discuss the implications of using money for consumption and direct re-investment. Then, I will explain the role of savings and elaborate the particularities of using bank accounts, banking associations and cow-stocks for this. Following, I will elaborate the different sources of investment that farmers make use of and in the end show that farmers' investment capacity plays an important role in the differentiation of business strategies.

Consumption and re-investment

Farmers with different business strategies have very specific ways to manage their money flow. Money earned after a harvest can be used for either consumption, re-investment or saving. Both expenditures on groceries and on other issues to improve one's living conditions can be characterised as consumption. Re-investment covers the purchase of new inputs, but also the investment in other productive assets. Most farmers apply a combination of some of those options. The extent to which they use their money for those different options shows a lot about their investment capacity.

Obviously everyone uses part of his income for the daily consumption of groceries. However, for marginal farmers this is the main or even the only thing on which they spend money. For two of them shock events and a complete lack of irrigable land, constrained any production surplus that would allow for expenditures beyond daily consumption. The other marginal farmers use part of their money to buy inputs for their next fields, though not regularly and insufficiently for a step-by-step expansion of their plot. The following quote from a marginal farmer shows one of the many occasions in which the impact of money on farmers' production system became clear and provides an example of the irregular character of re-investment by a marginal farmer.

> [BvdP]: Have you already planned the size of your next field?
> [LC]: I will make the plan if I have more money. If I have a lot of money I will grow a big field, if I have little money I will grow a small field.[93]

The next quote from another marginal farmer is an example of the uncomfortable lack of explanation that often arose when I asked about the causes of a sudden lack of money.

> [BvdP]: Did you use more inputs in the past?
> [AC]: This is the first year I do it like this [not using inputs], because I did not have money.
> [BvdP]: What happened that you did not have money?
> [AC]: *Laughing nervously*

[93] Field notes 03/10/11

[DM]: It is difficult for him to answer that question.
[AC]: I am tired so I don't know how to answer this question.[94]

Other farmers with whom I discussed the issue often suggested that those particular farmers spend their money on beverages, which affects both their available money and ability to work.

Contrary to the irregular purchase of inputs by marginal farmers, most other farmers buy the inputs for their next field right after the harvest of their previous field. This is especially the case for both the intensive and land renting tomato producers[95]. Farmers explained me that the main reason for buying inputs immediately is that money that is kept at home is often prone to get lost, as for instance shown by the following quote from an intensive tomato producer.

[BvdP]: Where did you buy your fertiliser?
[TC]: I bought it in Messica. If I have money I can buy more bags and keep them for myself. Before I planted this tomato field I bought three bags because I had money, and it's better to keep fertiliser than to keep money.[96]

This practice allows the intensive tomato producers to produce year-round and prevents them from having to wait for money to buy inputs. The latter is also important for the land renting producers, since they only rent their field for a limited period. In the next paragraph I will explain that the diversified farmers and innovators have a very distinct way for re-investment, as they use their money for savings and withdraw it again when they need it for buying inputs or other productive assets.

The intensive tomato producers use the rest of their money to improve their living conditions, e.g. by building a new house or buying furniture. Some of the land renting tomato producers, diversified farmers and innovators do so as well, but to a lesser extent. This is probably due to respectively a lower income due to their limited production period and the preference of using money for savings rather than consumption.

The role of saving

The innovators and diversified farmers use most of their money for savings, either in the form of a bank account, banking association or cows. Savings are an indication of a farmer's profit from his/her past production, however the case of the intensive tomato producers shows that such profit can also be expressed by things like a big house or a motorbike. The main difference is that savings can be easily transferred into available financial resources, whereas such consumed investments cannot. Regarding savings, it may not be surprising that most of the innovators have a bank account or joined a banking association, whereas most diversified farmers, who practice more traditional business strategies, invest in cows. However, a combination is also possible, as for instance shown by the next quote of a diversified farmer who has both many cows and a bank account.

[JK]: I put money on the bank after harvesting.
[BvdP]: Did you also use a part of the money for buying the inputs of your next tomato field?
[JK]: No, if I need inputs I just go to the bank.[97]

Like in the quote, farmers use savings mostly to re-invest their income at a later stage. Considering the fact that the investment pattern throughout the year is more variable for the innovators and diversified farmers than for the intensive tomato producers, saving is a fitting option for that. Additionally, saving allows farmers to build up capital for major consumption expenditures, periods of shock events or for long-term investments. In chapter 5.3 I will explain that the diversified farmers use their savings mostly as a form of risk management.

[94] Field notes 24/11/11
[95] Except for one farmer who gets his inputs on credit from his customer.
[96] Field notes 13/10/11
[97] Field notes 22/11/11

The innovators are the only farmers that do long-term investments in technical production assets like sprinkler irrigation and tubes or marketing assets such as a truck. They mostly use the money from savings for consumption and to purchase inputs, so that they can use the money from the harvest of a field for a particular long-term investment. The following quote from a young innovator with a bank account is an example of that.

> [BvdP]: What did you do with the money you earned after your tomato harvest in May?
> [TS]: After the harvest I went to Zimbabwe to look for a car. I bought an open truck there. I had the idea to take it here to take tomatoes to the market in Messica or Chimoio.[98]

Though the described functions of savings characterise both the use of a bank account, banking association and cows stock, there are some differences with respect to its use and suitability for the different business strategies. Therefore, I will now explain the three different options into more detail. The four farmers with a bank account make use of the regular banks situated in the cities of Manica or Chimoio[99]. They need to go there to deposit or withdraw their money, which obviously involves some transport costs. I do not have further details about the requirements and interest of such accounts.

Another way of saving is joining a banking association like two innovators have done. There is one banking association in the research area and at least one in Messica[100]. The one in the research area is called *Rodzai Pfungwa* and has about 80 members[101]. Each month, members can either deposit money or take credit against a monthly 10 per cent interest rate[102]. The amount of deposited or rented money differs per farmer; the innovator I interviewed deposited 20,000 Mts. Farmers expect from each other that they both deposit and rent, as for instance shown by the following answer of that same innovator on a question from my local supervisor Wouter Beekman.

> [WB]: Are there also people that only put money there?
> [FC]: It can happen. They will also get the interest, but we do not like that people, because we also need people who take credit.[103]

Hence, in order to make use of a banking association a farmer must be willing to both deposit money and take a loan.

The third way of saving is by increasing one's cow stock. Traditionally a large cow stock is a sign of status that farmers build up in their life (Kalinda et al., 2000). It can be used for a variety of functions, including capital saving, production and transport, and as a source of manure. Most farmers seem to build up their cow stock for a variety of those functions, and sell a cow in case of a sudden need of money, e.g. in case of a shock event or when paying a bride price. However, one diversified farmer uses them as a more liquid capital source, like he explains in the following quote when talking about buying and selling cows[104].

> [BvdP]: Do you sell a cow when you need money or do you sell them any time and put the money on the bank?

[98] Field notes 24/11/11
[99] Banks mentioned are Barclays, Banco Oportunidade and BIM.
[100] There may be one more ban king association in the research area, but I am not sure about its role. This association called *Africare* works with orphans and apparently has some banking activities as well. However, the farmer who told us about it did not know more about it, since only his wife was involved in it.
[101] Probably not all of them are actively banking though. It was set up 5 years ago as a farmers' association, but in the last three years only the banking activities remained. Some farmers who were not interested in that have left the association or do not show up anymore.
[102] Thus, when depositing 20,000 Mts in February one will receive 40,000 Mts in the end of December. Since the members who take credit pay the interest for those who deposit money, credit and deposit must be balanced. In case of more credit demand everyone gets a little bit less, and in case of a deposit surplus part of the money will be stored without interest.
[103] Field notes 10/11/11
[104] The price of a cow varies from about 10,000 to 18,000 Mts according to its size.

> [CA]: I am not saving on the bank because it only concerns small amounts of money. I just buy one cow, and then sell it to buy inputs for the irrigated field, to pay helpers on the maize field and for home consumption.[105]

Considering the fact that an increasing number of farmers chose to use their income for other forms of savings implies that the prestige attached to one's cow stock may be subject to change. Most farmers who are banking possess a cow stock that is smaller than the average in the area, and thus prioritise money saving to investing in cows. An interesting question is still whether this is because money savings are a more liquid capital source, or because farmers consider it as a more secure option than keeping cows.

In short, the innovators and diversified farmers use savings to finance the re-investment of income in their production system and occasions of high money demand. However, the different characteristics of the three ways of saving have implications on their suitability for the different business strategies. Opening a bank account in town requires a bit of an innovative attitude, as I will explain in chapter 5.2. Since it is the most liquid option and farmers can use it for any amount of money, it enables both re-investments in the form of inputs and long-term investments. The use of cows as a capital source is mostly limited to the withdrawal of occasional relatively large amounts of money. Therefore, it plays a major role in risk management (see chapter 5.3) and only a limited role as capital source for re-investment. As a result, especially the risk averse diversified farmers possess many cows. A banking association is only opportune for farmers who next to saving also want to take credit sometimes, and therefore corresponds best to the less risk-averse innovators. Since it only concerns relatively short deposit periods, this option is mainly used for re-investments in the farm and not as a capital stock to deal with shock events.

Sources for investment

The paragraphs above show that re-investment of income from farmers' production, either by directly buying inputs or withdrawing from savings later, is an important source for investment. However, farmers also make use of a variety of external money sources, such as credit, customer-financed inputs, or informal borrowing. In this paragraph I explain how both internal and external sources for investment have allowed farmers to realise their current business strategies.

Re-investment of income

In chapter 3 I explained that farmers started to increase their cash crop production since the arrival of traders in the area in the late 1990s. I view this as the starting point for the differentiated development of business strategies. At the time, many farmers increased their production bit by bit. It could take some years to clear the field and gather enough money for inputs, like explained by the next diversified farmer who needed 8 years to expand her small field to her actual 0.4 ha.

> [JK]: I started expanding in 2000. The size depends each year on the work I have to do and the money for inputs. The first time I reached a big field like last year was in 2008.[106]

The example shows a case in which re-investment of own capital allowed a farmer to realise a considerable expansion of her irrigated field without using external money sources. However, it also shows that in this way it took a long time to achieve that. Farmers who did manage to start up a large production system at once by only using their own capital all used savings from former jobs. Nevertheless, once farmers realised the cultivation of a considerable field they often managed to finance their production system by re-investment from previous income continuously. At the moment 15 out of the 20 case study households only use their own income and savings for the purchase of inputs and other productive assets. Nevertheless, many farmers have used external inputs for the development of their farming system. Those farmers could start with relatively big

[105] Field notes 30/11/11
[106] Field notes 22/11/11

fields from the first year onwards, without any start-up capital. I will now explain the roles of respectively customer-financed inputs, informal lending and credit use.

Customer-financed inputs

Like I explained in chapter 3, some customers from Chimoio and Beira provide farmers with inputs and deduct the costs from the harvest revenue. Currently two case study households make use of this service and at least two more have made use of it in the past. Most customers who provide inputs on credit work with any farmer with sufficient land who is willing to cultivate a considerable field of tomatoes, however the amount of farmers per such customer is limited to about 3-6. The next quote from an innovator who received customer-financed inputs when he started producing for the first time also shows that a trader did not require any experience or proven quality from farmers for providing this service.

> [BvdP]: How did you find the money for your tomato field in February?
> [TS]: That is a long story. I came here in 2005 and a trader from Chimoio gave me inputs. I planted tomatoes and she deducted it from the price during the harvest. In the first harvest week I was not paid because she took the credit from it and in the second week I started to get money. We worked together for two years. After that she did not come anymore and I started on myself.[107]

Inputs on credit are only provided by tomato customers, so clearly the particular farmers could focus on tomato production only. Nevertheless, after they quitted their input credit agreements they could use their profit to re-invest and decide to start cultivating other crops.

Informal lending

Another external investment source farmers use to start up their farming system is informal lending. At least two case study household farmers used their social contacts to borrow some money from family or friends to start up, and paid back after harvesting. Not everyone has the social contacts that allow for this though.

Credit use

A third external investment source is credit from banks. A main distinction can be made between credit for agricultural inputs from a micro finance bank and credit for larger investments from regular banks. The latter is only used by one big farmer for major investments, such as the construction of a road. Many more farmers though make use of micro credit from *Banco Oportunidade*, an important micro finance bank in the research area that provides both inputs on credit to farmer groups and regular saving and credit possibilities for individual farmers.

Two case study household farmers make use of *Banco Oportunidade*'s credit provision under group responsibility[108]. Farmers pay a relatively low interest of 3 per cent per month[109] which they should pay back after harvesting the field for which they took a loan. Therefore, such credit is not suitable for financing long-term investments. Next to the interest, farmers have to pay a deposit of 15 per cent of their loan beforehand[110]. Even though the bank does not require the possession of land or cows as a guarantee, the three participating farmers I interviewed all used the credit to increase rather than to start up their farming system. This is illustrated by the following quote from a farmer who increased his irrigated field this year from 0.1 to 0.5 ha. In chapter 6 I will explain that the construction of a new canal was the initial reason for that, but the use of credit obviously supported the rapidness of the expansion.

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[107] Field notes 24/11/11

[108] This implies that if one farmer cannot pay back, the other farmers have to pay for that. The groups consist of about 4-6 farmers and work like micro associations with a president, secretary and treasurer. Some groups were formed by *Banco Oportunidade*, but others by some farmers themselves. The bank arranged a few meetings in the research area to inform farmers and administrate the groups. The group responsibility approach reduces the risk for the bank and lowers their transaction costs.

[109] Individual micro credit at the same bank used for urban starters has an interest of 5.5 per cent.

[110] In this way the bank will not make a loss if 15% of the farmers does not pay back.

[BvdP]: Why did you decide to engage in *Banco Oportunidade*?
[MA]: I want to have a big farm, and they can provide me with the money to realise that.[111]

Up to the period of fieldwork *Banco Oportunidade* used to provide farmers with the inputs, but in the near future they only want to provide the credit itself. Nevertheless, the bank is planning to increase its activities in the research area because of the high profit ratio in horticulture, as explained in the following quote by Vasco Nunes, who is responsible for *Banco Oportunidade*'s activities in the research area.

[VN]: The loan/profit ratio of maize is about 0.5, but for tomatoes only about 0.1. Therefore, we are very keen on supporting horticultural production; since the credit is relatively low compared to the profit that farmers can make.[112]

Some farmers indicated that they don't know how to access such credit provision. More farmers however deliberately chose not to make use of credit. They consider either the pay-back time too short or the interest too high and are afraid not to be able to pay back, as for instance shown by the following quote of a marginal farmer who currently produces only a little due to a lack of money to buy inputs.

[BvdP]: Have you ever thought of using credit?
[LC]: I want to, but I don't know how.
[BvdP]: Do you not know other people that have made use of it?
[LC]: Around here people get credit from the bank. I am afraid to take credit from the bank, because they have taken the cows of people that could not pay back.[113]

When looking at the different business strategies, three of the four innovators use credit whereas only two other case study households make use of it[114]. This contributes to the elevated investment capacity of innovators compared to the other farmers. Micro credit allows farmers to purchase inputs for a sudden expansion of their production. The same accounts for customer-financed inputs and informal borrowing, though those options are mostly used by farmers to start up their farming systems. Re-investment of own profit can be used to continue the cultivation of a certain irrigated area, however a step-by-step expansion with purely self-generated agricultural profit usually takes a long time. Customer-financed inputs, informal money lending and re-investment of own profit have been used by farmers practising a range of different business strategies for the development of their current farming systems. Hence, apart from the elevated credit use of innovators, the access to or use of a particular investment source is not a prerequisite for the realisation of a certain business strategy.

Impact of investment capacity on strategy differentiation

Though the use of particular investment sources does not explain the differentiation of farmers' business strategies, the logics of their investment practices does characterise the different strategies. Investment capacity can take many forms, such as the ability to finance long-term production assets, to re-start after a shock event or to maintain a large intensive production system. Different strategies demand different forms of investment capacity and thus result in different investment practices. This implies that diversified farmers use savings in the form of cow stocks to decrease risks, whereas innovators use liquid savings and credit to invest in innovative production and marketing assets. Intensive tomato producers on the other hand, directly re-invest their profit in new inputs and use the rest of their money for improving their living conditions. The land renting tomato producers do the same, though to a lesser extent. Hence, farmers' investment practices are an essential aspect of their business strategy.

[111] Field notes 15/09/11
[112] Field notes 29/11/11
[113] Field notes 07/11/11
[114] Including both credit from banks and banking associations.

A particular case in which investment capacity is the cause rather than the outcome of one's business strategy concerns the marginal farmers. It is basically the high consumption/re-investment ratio that characterises their strategy, which causes that they are unable to expand their cultivated area[115]. The incidental use of external investment sources has not structurally changed their situation. This is also showed by the following quote of a marginal farmer who once cultivated a large field since he used customer-financed inputs, but after that fell back into marginality again.

> [KT]: We have always had small fields due to problems with money.[116]

Next to being a matter of choice for a particular business strategy or money use, investment capacity is also dependent on farmers' skills and knowledge. The decision to reserve part of the profit in some way for re-investment in a production system requires planning skills and discipline. For saving and credit use farmers need knowledge about bank services and banking associations. Social skills can be helpful in borrowing money or attracting customer-financed inputs. Nevertheless, the latter external investment sources are no prerequisites for the realisation of a particular business strategy.

In short, investment capacity is both dependent on the logics behind farmers' business strategies and their skills and knowledge with respect to investing. I consider investment capacity as an essential capacity for farmers to realise a particular business strategy, however it is certainly not the only one.

5.2 Innovation capacity

Innovation is a process in which someone introduces knowledge and uses this to change his behaviour and practices (Spielman et al., 2011). Chambers et al. (1989) explain that resource-poor farmers experiment, adapt and innovate continuously. I also consider this as an intrinsic feature of farmers. Nevertheless, I only classified four farmers out of the twenty case study households as innovators. I classified those farmers as such, because they innovate beyond the continuous farming system improvement that all farmers aim at. The four innovators search both for new market opportunities and opportunities to improve their production system. They realise this by increasing the profitability of their marketing practices or current cropping systems, but also by adapting their production system to such market opportunities, e.g. by producing unconventional crops as garlic or green pepper. Furthermore, the innovators do not only identify such innovations, but also invest in its realisation. Hence, I characterised those farmers as innovators since they have made their complete business strategy subject to opportunities. In this paragraph I first discuss some examples of innovations in the research area. Subsequently, I explain the roles of skills, knowledge, networks and financial resources in innovation and discuss why the innovation capacity of innovators is different than that of other farmers.

Examples of innovations in the research area

An interesting innovation in the area is the use of sprinkler irrigation, which saves time and water compared to furrow irrigation. One innovator learnt about sprinkler irrigation when he went to agricultural school in Zimbabwe and started to apply this soon after he experienced the difficulties of furrow irrigation. Another innovator who saw that, informed himself about it by asking the first farmer, like he explained in the following quote.

> [BvdP]: How did you learn about sprinkler irrigation?
> [JK]: I saw another farmer doing that, and so I wanted to do that as well because it is an easy way to irrigate.
> [BvdP]: Have you asked the other farmer for advice?
> [JK]: I have his phone number and I already asked how to do it. That farmer told me to come to his field so he could explain me.

[115] For four marginal farmers, major disturbances or an extreme lack of production assets also contributed to that.
[116] Field notes 24/11/11

[BvdP]: Have you been friends before?
[JK]: No we were not. I just saw him using sprinklers and so I stopped and talked to him.[117]

The first farmer experienced a problem and solved this by using the knowledge he obtained at school. The other farmer noticed this and informed himself about the issue. The fact that the second farmer did not know the man implies that this farmer did not need any experience or particular network to access this knowledge. It was just his attitude to look for opportunities that provided him with the necessary information. I met more farmers that were interested in sprinkler irrigation. However, the difference is that the innovator took the risk to invest and realised the innovation whereas other farmers did not .

Another example is the innovation to rent a truck to sell products in the city instead of selling from the farm-gate. One innovator knew about marketing since he had worked as a trader before. Another one however just went to the city to look around and now practices the same marketing strategy. Again, his opportunity-taking attitude could provide him with sufficient knowledge to realise the innovation. Some other farmers have also thought about renting a truck or even experimented with it. However, the following quote from an intensive tomato producer shows that experimenting alone does not result in innovation.

[BvdP]: What do you think about renting a truck yourself to go to Chimoio?
[KZ]: It's not possible to go there yourself. All customers that see you will tell each other not to buy those tomatoes until the evening. They don't want to see farmers there because they want to buy themselves here at the field for low prices.
[BvdP]: Why do you think that? Did you experience that, or did you hear it from other farmers?
[KZ]: It can happen. Some years ago I went with onions to Beira and this happened to me.
[BvdP]: Is it also not good in periods with few tomatoes? Since many customers want tomatoes then.
[KZ]: It's the same. They will sit down and discuss to pay a low price.[118]

This farmer had an unsuccessful experience with onions in Beira. However, if he would go to Chimoio with tomatoes the situation had been different (see the results of other farmers in chapter 3). Since this farmer seems not willing to risk a similar experience, he will not easily discover the tomato market opportunities in Chimoio. Another farmer who is planning to rent a truck next year in the peak production season may face the same disappointment, since one innovator mentioned that using a truck is only beneficial during the high price season[119]. However, this farmer does not see the benefits of renting a truck in the high price season since the price he gets at the farm in that period is also high. If these farmers would have either the experience or the analytical power to fully understand the market, they had probably come to a different conclusion. Hence, in these cases experimenting alone without a full understanding of the market dynamics resulted in wrong conclusions rather than innovation.

A third example concerns an innovator who constructed a road to his farm, after another road was destroyed by the rain. He invested a lot himself, but also successfully asked the government to support him. Rather than in the physical road, the innovation here lays in arranging the funding of its realisation. The farmer used his network for the realisation of the innovation, rather than to obtain the knowledge. Another innovator had the innovative idea to arrange collaboration among neighbouring farmers in weeding their fields. Here too, the idea arose by analytic problem-solving, and the farmer used his social network to realise the innovation.

[117] Field notes 25/10/11
[118] Field notes 25/11/11
[119] Nevertheless, in chapter 3.4 I explain that even in November farmers can increase their profit by selling directly in Chimoio.

The role of skills, knowledge, networks and financial resources

I will now briefly discuss the roles of respectively skills, knowledge, networks and financial resources in the described innovations. All innovations require analytic skills to identify opportunities for improvement. The example of using a truck for marketing tomatoes shows that even when copying an innovation from other farmers, one needs to fully understand the matter in order to use the innovation in a beneficial way. An opportunity-searching attitude basically results from analytic skills, since it requires the capacity to understand issues and apply them to one's own business. The possession of analytic skills obviously differs among individuals naturally, but is also a matter of education. Therefore, it is not surprising that the only farmer who told me to have been educated at an agricultural school in Zimbabwe is also an innovator[120]. The fact that only a limited share of the Mozambicans is able to pay for higher education implies that differences in analytic skills originate from structural differentiations within the society.

Next to analytic skills, education clearly provides knowledge as well. Specific knowledge from outside allows someone to introduce an innovation as the first person in the area, as happened with the introduction of sprinkler irrigation. The example of the former trader shows that knowledge from previous experiences can also account for this. However, for most innovations or for copying innovations from other farmers, analytic skills can compensate for a lack of knowledge, as shown by the innovator who copied the idea of sprinkler irrigation and started using a truck without former trading experience.

The examples also showed that a particular social network is not required for copying an idea. However, in order to get more information it is important to discuss the issue with the particular farmer. Thus, social skills support the transfer of knowledge. The last two examples show that innovators do not only use their social network to inform themselves, but also to realise their innovations. This decreases the need for own financial resources to realise an innovation.

Though some innovations can be executed without much costs, such as organising other farmers or cultivating different crops, most innovations I discussed do demand some investment. In the previous chapter I explained that the investment capacity of innovators is higher than that of other farmers since they make use of savings and credit. Again, one needs analytical and planning skills to assess the profitability of such investments. Moreover, an opportunity-searching attitude and networking are required to inform oneself about such finance opportunities. Both saving and credit use also demand the discipline not to use the money for consumption. Next to financial skills, the investment capacity of innovators is elevated because of their willingness to take a risk, contrary to e.g. the diversified farmers. Here too though, analytic skills contribute to that because it allows the innovators to get an overview of the possible gains and risks, and thus enables a deliberate decision to take the risk of an innovation or not. Hence, next to the impact of the different logics behind farmers' business strategies on their investment capacity as explained in chapter 5.1, a range of specific skills also contributes to the fact that innovators are able to arrange sufficient financial resources to realise an innovation.

To conclude, the main factor that distinguishes the innovators from the other farmers are their analytical skills which they use to address problems and to benefit from opportunities to improve their business strategies. Knowledge and previous experiences can be useful, but are not required to maintain an innovative business strategy. Neither is a particular social network, however social skills to discuss innovations with other farmers can be important. Another main difference between innovators and other farmers is the realisation of their idea. In some cases innovators used their network to support an innovation, but in most cases they invested themselves. Both the innovators' willingness to take a risk and their analytical, planning and discipline skills which they need to identify and manage the use of savings and credit account for the elevated investment capacity, and thus for an elevated innovation capacity of innovators.

[120] He went to the 'Wondewali' agricultural school in Mutare, Zimbabwe for 11 years.

5.3 Risks and resilience

The occurrence of shock events beyond one's own control can have a great impact on farmers' production. For 5 out of the 20 households I visited, recent shock events were the main reason to cultivate much less than they did before. However, only one of those households seems to face structural problems as a consequence. In this chapter I will first show the impact of four shock events that took place in the area, respectively illness, fallacies, failed harvests, and affected cow stocks. Following, I will discuss the reasons for differences in resilience among farmers and explain the impact of shock events and risk management on farmers' business strategies.

Shock events in the research area

The most abundantly present shock event that I encountered in the research area is illness. Illness affects both a household's labour force and financial resources[121]. In the following quote a marginal farmer explains this when talking about the impact of malaria on her household last year.

> [BvdP]: What crops did you grow last year?
> [EA]: Last year we only had beans because we did not have money for seeds and pesticides, and we had malaria. All adults [in the household] were ill for a long time. They were following up each other's disease all the time. And if one person is ill, the other cannot work either because he needs to take care of the other.[122]

Two farmers that were ill decreased their irrigated area from 0.5 to 0.2 ha[123] and from 0.4 to 0.1 ha. A widow farmer who was ill two years ago, lent her complete irrigated field of 0.4 ha to somebody else. Their resilience seems mostly a matter of their capital stock. The widow, a diversified farmer with 7 cows, continued the year after by cultivating her usual 0.4 ha. The same seems to be true for the other diversified farmer who has 11 cows. However, the third farmer had no cows and went from 0.2 ha to no irrigated production at all in the year after. The fact that he had no profit from his production and no capital stock to transfer into financial resources for the purchase of new inputs made him unable to recover quickly[124]. In two years this household, which used to practice a diversified strategy, became stuck in marginality.

The second shock event I discuss here are fallacies in a farmer's family. Fallacies and the associated costs for treatment and funerals imply a sudden loss of capital on top of the emotional and eventual labour damage in the household. A successful innovator indicated that last year he produced only a quarter of his normal production due to the costs of a fallacy in his family. Currently he is still doing so, but since he attributes this to a broken canal I do not have insight into his recovery and resilience.

Failed harvests constitute another frequent shock event in the area. Its reasons vary from rain damage and heat to destruction by cows or monkeys. The latter caused that one diversified farmer had only 0.04 ha left of her former 0.4 ha of irrigated production. For the same reason, two marginal farmers[125] told me that their complete gardens had been destroyed, and another farmer does not grow irrigated maize on a field because monkeys will eat it. Several farmers explained me that their tomato harvests had been destroyed by the heat. In the following quote a land renting tomato producer explained me that he had no profit from his tomato field harvested in the beginning of November, after we discussed the harvest of his first tomato field.

[121] Directly in the form of doctor and medicine costs, and indirectly in the form of harvest loss.
[122] Field notes 21/10/11
[123] The 0.5 ha were actually two cycles from 0.3 and 0.2 ha each, whereas the next year they only had one cycle of 0.2 ha.
[124] In the paragraph about failed harvests I will explain that rain damage of his maize harvest also contributed to this.
[125] One of them does not belong to the 20 case study households.

> [MB]: I did not have profit from the second tomato field. The leaves and tomatoes dried due to the sun. I only harvested two times from that field. Now you can see many tomatoes on that field, but all of them are rotten.[126]

Nevertheless, such failed cash crop harvests seem to have relatively little impact on the particular households. One of the marginal farmers had already replanted his field, and the others are planning to do so. The impact on marginal farmers was probably limited because the particular fields were very small. The diversified farmer and land renting producer however are also planning to continue their business as usual. Though I did not further discuss the issue with the particular farmers, I expect that they are able to do so because they both have other fields from which they can harvest before the month in which they want to start planting again.

Another example of harvest failure is damage on the maize field, either by too much rain or drought. Since most maize production is not situated on irrigable fields, irrigation cannot compensate for a lack of rain. Depending on the size of one's maize production, damage leads to a decreased income or to the need to start buying maize when one's own production has been consumed. The marginal farmer I quoted above about the impact of malaria also faced a rain-damaged maize harvest in that same year. Other farmers in the area had probably experienced the same weather, but no one had mentioned its impact on their available financial resources, even though I discussed that subject with practically all case study household farmers. The fact that the particular marginal farmer already had no income that year as a consequence of malaria has clearly affected their resilience to a damaged maize harvest.

The fourth important shock event in the area concerns cows that get sick, die or get stolen. In chapter 5.1 I already discussed that cow stocks play an important role in capital savings, and that their role in maintaining farmers' social status may be subject to change. In chapter 5.4 I will explain that their role as a productive asset does not depend a lot on the size of the cow stock. However, though the size is not a main indicator of the productivity of one's livestock, the possession of a pair of oxen is. Therefore, poor farmers who lack productive oxen can actually be limited in the size of their maize field. While we were measuring his maize field, a marginal farmer told me the consequence of the fact that one cow had been stolen.

> [PA]: I will only grow a small field of maize this year, because last year my cow was stolen. I want to rent one now. This year, the maize will only be for my own consumption.[127]

This farmer used to sell only maize, but will not be able to do so next year. An innovator got all his five cows stolen, but used money from his bank account to hire a worker with cow. His business strategy was not affected, both because of his available money and his focus on cash crop production, which needs less area to be ploughed. With respect to the function of cows as a capital stock, the case of the innovator shows that spread savings reduce the risk of losing all capital stocks at once. Therefore, the impact of losing one's cows depends on the use of a cow stock in capital saving. Farmers who have an additional cow stock next to savings in other forms do not face major problems, but farmers who sell cows in order to withdraw money for buying inputs have been affected in their business strategy.

A fifth abundant shock event in the area concerns canal intakes that break down due to extreme discharges in the rainy season. I discuss this subject into more detail when discussing the irrigation system dynamics in chapter 6.

Resilience

The discussed examples show that similar shock events can have a different impact on the business strategies of different farmers. The resilience of a household can be defined as a household's capacity to absorb shocks while still maintaining its functions (Traerup, 2012). "The more resilient a household, the greater the shocks

[126] Field notes 07/11/11
[127] Field notes 21/10/11. It concerns a farmer who was not part of the 20 case study households.

and disturbances it can absorb" (ibid, p. 257). Most shock events I discussed caused farmers to temporary decrease their production. I consider the time span they need to recover and to continue their business as they did before as the main indicator of farmers' resilience.

Several authors point at the importance of informal networks or social capital in strengthening farmers' resilience to unexpected shocks (e.g. Roncoli et al. 2001; Traerup 2012). Since at the time of fieldwork the assessment of farmers' resilience was not within the scope of this research I have not specifically asked farmers how their relatives and friends support them in case of a shock event. Analysing its role retrospectively would not be possible either, as explained by Lyon (2000) who states that there are serious difficulties in examining the stock of farmers' social capital anyways. Since this is different with respect to farmers' financial capital stocks, I will show that in most cases there is co-occurrence of resilience and capital stocks. It should be noted however, that this is also based on retrospective analysis rather than on farmers' explanations. Hence, though I do acknowledge the role of social networks in farmers' resilience to shock events, e.g. in the form of money lending or food sharing, the data obtained during my fieldwork only allow me to discuss the role of capital in this respect. Moreover, I will argue that the skills and financial capacity of innovators, as elaborated in chapter 5.2, also increase farmers' ability to respond to shock events.

The examples show that farmers with less capital have more problems to recover from shock events than farmers with more financial resources. The diversified farmers have built up most savings in the form of cows, and all of them were able to continue their business as usual in the season after the shock event. With respect to the innovators one decreased his irrigated area and one did not, however the one who decreased his area still cultivates the largest irrigated area of all case study households. Their business strategies remained the same. Unless it concerns a very small field, the marginal farmers do not show any quick recovery after a shock event. Some changed their strategy and started to work as a paid labourer rather than to produce crops for sales[128]. In short, farmers with capital stocks from which they can withdraw money to continue their business show a more quick recovery than the farmers who do not. Hence, capital stocks seem to increase farmers' resilience.

Next to this, the examples show that the innovators prove resilient as well, even though their capital stocks are considerably smaller than that of the diversified farmers. I consider this to be caused by the particular skills and investment capacity that characterise their innovation capacity (see chapter 5.2). With respect to the example about a broken canal that will be discussed in chapter 6, the involved innovator managed to use trees and later buy tubes to repair the canal within a couple of months. He used his opportunity searching attitude to look for tubes and his financial resources and willingness to take a risk to invest in its purchase. Hence, the analytic skills and financial means that characterise farmers' innovation capacity also enable them to improvise and to respond better to shock events.

Even though the particularities of farmers with different business strategies influence their resilience to shock events, a shock event on itself does not usually force farmers into a particular business strategy. Only one of the six marginal farmers was forced into this by a succession of shock events[129]. After a shock event, most farmers temporary produce less but maintain their strategy. Indirectly it does play a role however, since risk management forms an important differentiator of the five business strategies.

Risk management

Risk management refers to the way in which farmers adapt their business strategy to the possible occurrence of a shock event. The most pronounced example of risk management that all farmers respect is their aim of self-sufficiency in maize, so that they do not have to buy their staple food. In the following quote an intensive

[128] The intensive and land renting tomato producers did not face any shock events this year. Nevertheless, I would expect that the intensive producers are relatively resilient thanks to their accumulated capital, and that the land renting producers are more vulnerable since they have less financial resources and need to gain most income in a relatively short period.
[129] A season of illnesses was followed rain damage on the maize harvest.

tomato producer explains that for him this is mainly a matter of spreading the risks attached to the production of tomatoes.

> [BvdP]: Why do you not grow more tomatoes and buy some maize?
> [KZ]: Because sometimes tomatoes get a disease and it can be a problem.[130]

However, apart from this farmers have made different choices. Especially the diversified farmers have deliberately minimised risks in all aspects of their business strategy. Their additional income sources and high crop diversity limits the impact of failed harvests, the fact that they only cultivate common crops implies that they have sufficient knowledge about the production and marketing particularities, and moreover they limit the costs for inputs and transport so that they can never lose a lot of money. Hence, their complete strategy seems to aim at spreading risks and saving money.

The innovators save a bit of money as well, but with the goal to enable themselves to invest in productive assets rather than to increase their resilience for shock events. Nevertheless, like I explained above they also manage to be resilient, even though their business strategy does not seem to be based on risk management. The intensive tomato producers all cultivate a lot of maize, which can be considered as a risk averse activity since this only requires land and labour. The above quote suggests that this may be a form of risk management to compensate for the money they spend on their intensive tomato production, however I have not verified this with the other two farmers. The business strategy of the land renting tomato producers does not seem to include any activities aiming at risk management. Their lack of land and consequent obligated short production period also provide them with little flexibility to include such measures. The marginal farmers are obviously the most vulnerable for the consequences of shock events, however risk management in the form of saving and assuring self-sufficiency only seems to be the objective for some of them.

Concluding, shock events can have a major short-term impact on farmers' production systems. Nevertheless, most farmers seem sufficiently resilient and in the following season they continue their production like they did before. Farmers with a large capital stock or liquid savings showed a more quick recovery than farmers without such means. However, only when a succession of shock events took place a household faced structural problems to recover. The possibility of shock events does influence farmers' business strategies though, since farmers practice a particular form of risk management. The diversified farmers practice an overall low-risk strategy, whereas the intensive tomato producers only took a few measures. Though the business strategy of innovators is rather aimed at using the best market opportunities, their particular innovation skills also increase their resilience to shock events. The marginal farmers and to a lesser extent the land renting producers have less possibilities to build in forms of risk management in their business strategy, however considerable differences among individual marginal farmers can be observed in this respect. Hence, the occurrence of shock events has an important impact on farmers' business strategies, by the various ways in which farmers build in measures of risk management.

5.4 Organisation of labour

Labour has been mentioned by several researchers as the most constraining factor for cash crop cultivation and market participation of smallholder farmers in Mozambique (Green et al. 2006; Lukanu et al. 2007). During my fieldwork however, only a minority of the farmers indicated labour as a major constraint in their farming system. When comparing the farming systems of the case study households of this research with the systems of those studies, I found some essential differences that may account for that. First, the irrigation systems in the research area allow for cash crop production beyond the period of maize production, and so limit competition of labour between food and cash crops. Second, the high availability of day workers in the area implicates that farmers are less dependent on available household labour than in less densely-populated areas. Third, the use of animal traction accounts for a much lower labour requirement in the research area than in the

[130] Field notes 25/11/11

other studies I referred to. Hence the particular characteristics of the research area account for the fact that labour constraints to cash crop production are relatively minor.

Though labour constraints in the research area are obviously less decisive than in the mentioned case studies, differences in the organisation of labour may still have accounted for the existence of different business strategies in the area. In this chapter I first explain how farmers in the area organise their activities throughout the year. Then, I discuss the roles of different labour sources that farmers make use of. I show that household labour and permanent workers cannot be accounted for the adoption of different business strategies or the size of farmers' cultivated areas. Following, I explain the particularities of peak demand activities and show the important but not decisive role of employing day workers. I continue by showing that physical productive assets like cows or technology only play a role in case of an extreme lack of it. In the end I argue that the organisation of labour has not played a major role in the emergence of different business strategies.

Organisation of labour throughout the year

The production system of farmers in the area is basically characterised by two periods; the dry and the rainy season. The cultivation of maize in the rainy season implies an important difference in labour demand between those periods for all farmers. In figure 11 I depicted the monthly labour demand of the farming system of an innovator who produces cash crops during the whole year. Though he only produces maize for the consumption of his own household, it shows that the claim of maize production on his labour sources is enormous. Weeding is the most time consuming activity, followed by harvesting and ploughing. One cycle of maize requires about 76 person-days/ha, whereas one cycle of tomatoes needs 208 person-days/ha[131]. Nevertheless, the fact that the maize fields are much larger than the irrigated fields is the main reason for the heavy labour burden of maize production.

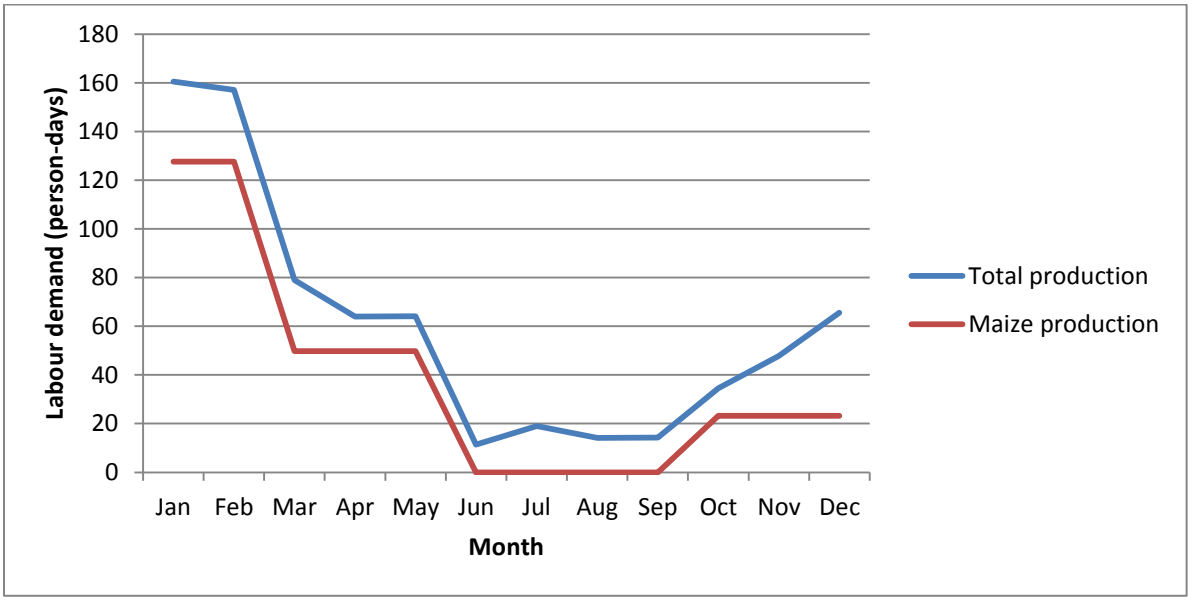

Figure 11 Labour requirement per month of the farming system of Mr Jorge Kiweda.

[131] Maize production requires ploughing and seeding (11 pd/ha) + weeding (41 pd/ha) + harvesting (24 pd/ha). Tomato production demands ploughing (6 pd/ha) + ridge making (21 pd/ha) + transplanting (40 pd/ha) + fertilising (42 pd/ha) + weeding (39 pd/ha) + pesticide application (4 pd/ha) + irrigation (28 pd/ha) + harvesting (29 pd/ha). All values are averages from a number of case study households, except for the values for ridge making, pesticide application and harvesting maize which are taken from Lukanu et al. (2007).

Mr Kiweda is an innovator who cultivates cash crops throughout the year and who only produces maize for household consumption The maize fields count 6.2 ha in total and the size of the irrigated field varies from 0.2 to 0.7 ha[132]. The blue line indicates the labour requirement of his complete production system and the red line that of his maize production.

The figure will be slightly different for the other business strategies, though its main shape will be the same. The diversified farmers and intensive tomato producers both produce a considerable amount of maize for sales on top of the amount needed for consumption. Therefore, the labour demand in the rainy season will be even higher for farmers with those strategies. The land renting producers and most marginal farmers do not produce cash crops during the rainy season and no maize for sales either, which implies that labour demand in the rainy season for those farmers will be slightly lower than in figure 11. The figure clearly shows that labour demand in the rainy season is much higher than in the dry season, and my interviews with farmers confirmed this . Moreover, since there is a considerable amount of farmers and villagers who only cultivate crops during the rainy season, the availability of labour is actually higher during the dry season. Hence, the total labour availability in the area is definitely not a constraining factor during the dry season. For the rainy season though, farmers did not indicate the availability of day workers as a problem either. One farmer with average sized fields explained me that he never faces problems to find day workers.

> [BvdP]: Are there always enough workers available?
> [MA]: It's easy to find someone, because everyone needs money. Some of them are farmers and others are people from the village.[133]

In fact only six of the twenty case study households do not temporarily employ workers to help them weeding their maize fields. This shows that even production systems with the objective of consumption are being capitalised. In chapter 7 I will explain that this may point at a process that has been stimulated by the passed market development in the research area.

Most farmers adapt the timing of their cash crop production to their maize production, as for instance illustrated by the following quote of an intensive tomato producer. My translator David Muchena further explained this to me.

> [BvdP]: In what month do you have your biggest tomato field?
> [TC]: The biggest field I plant in March-April because then I can just work on my tomatoes. I do not have to work on the maize then.
> [DM]: Harvesting maize is not a big job. The big job is weeding, but that is already done earlier.[134]

Some farmers do not produce cash crops at all during the rainy season, and even for the dry season some farmers indicated that they cultivate smaller areas because they cannot meet the labour requirements. Other farmers do produce cash crops during the rainy season since they have managed to meet elevated labour requirements by using household labour, paid workers, and collaboration with other farmers or technology. In the next paragraphs I will discuss the roles of each of those factors.

Role of permanent labour

By a case study in Northern Mozambique, Kalinda et al. (2000) show that farm size and the number of household members are positively correlated. Since all case study households of this research aim at producing at least enough maize for their own consumption, the same could be expected for this area during the rainy

[132] I did not measure the size of all his maize fields, but I made an estimation based on the formula of Haarman (2000) to calculate the equivalent maize consumption of his household. I then used the maize field size of another farmer in the research area with a known maize consumption equivalent to estimate the size of the maize field of Jorge Kiweda.
[133] Field notes 15/09/11
[134] Field notes 28/11/11

season[135]. However, all farmers who produce cash crops or maize for sales in the rainy season on top of this make use of temporary workers rather than extra household labour. In the dry season, cash crop production does not depend on the size of the household either. Figure 12 shows that farmers with more available household labour do not necessarily cultivate larger irrigated areas. Moreover, in chapter 4 I showed that business strategies are not featured by a particular household composition. Hence, household labour only becomes a determining factor in case the adult household members are stuck by disease, as I showed in chapter 5.3. The available household labour consists in most cases of a farmer and his wife. A second wife or children that can help during the weekend or holidays can increase the available household labour[136]. The following table shows the annual division of labour within the household of Jorge Kiweda, the farmer whose labour demand was depicted in figure 11.

Table 4 The intra-household labour division of Jorge Kiweda's production system in one year

Crop	Activity	Area (ha)	Work load (Person-days)	Actor
Maize	Ploughing	6.2	35	Farmer
	Seeding	6.2	35	Wife
	Weeding	6.2	255	Farmer, wife and workers
	Harvesting	6.2	100	Farmer and wife
Tomatoes / Beans	Ploughing	0.9	5	Worker
	Ridge making	0.9	19	Farmer and wife
	Transplanting and applying phosphate	0.9	36	Farmer, wife and 6 workers
	Applying ammonium-nitrogen	0.9	38	Farmer, wife and 6 workers
	Weeding	0.9	35	Farmer, wife and 4 workers
	Applying pesticides	0.9	4	Farmer
	Harvesting	0.9	26	Farmer, wife and 6 workers
	Irrigation	0.9	25	Farmer
Total Tomatoes/ Beans[137]			**56**	**Farmer**
			28	**Wife**
			103	**Workers**

The figure shows that Mr Kiweda spends about twice as much time on his irrigated crops as his wife. So, though women are mostly responsible for the cultivation of consumption crops and men for cash crops, they work together if needed. Regardless of the crop, men are supposed to do the physically heavy jobs such as ploughing or spraying pesticides, and women help them when transplanting, weeding and harvesting. Herding cattle is often appointed to children. The table also shows the important use of temporal workers for both cash crop and maize production, the role of such labour will be discussed later in this paragraph.

[135] Since for most case study households I could not measure the size of all their maize fields I cannot show the correlation myself.
[136] In figure 12 I counted each child who helps during the weekend as 1/6 person equivalent.
[137] Since I do not know the amount of workers he employs for weeding his maize field, I only calculated the total labour division of his tomatoes and beans.

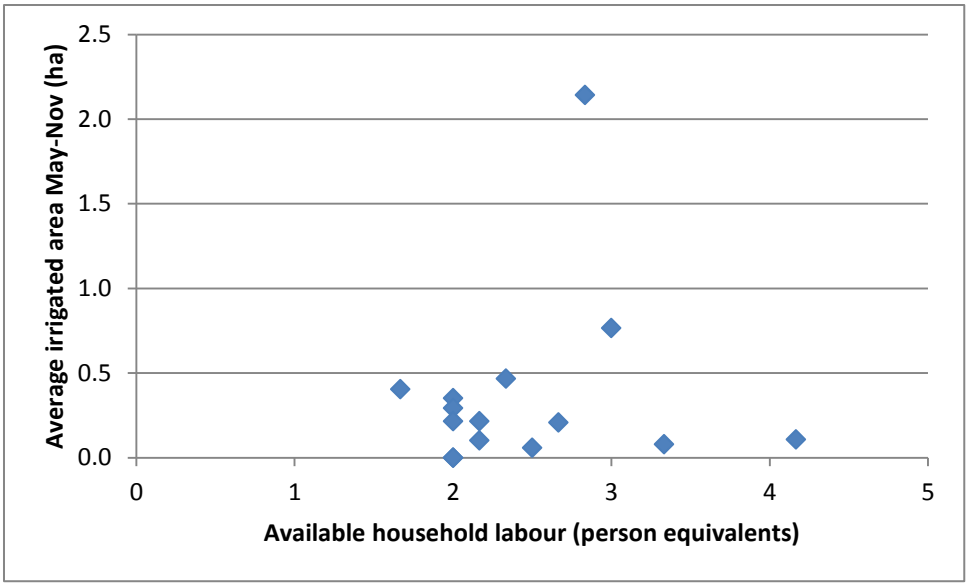

Figure 12 Case study households' average irrigated area per available household labour force
The graph shows that there is no relation between available household labour and the size of a farmer's irrigated area from May to November.

The three farmers with the largest irrigated area in figure 12 all employ one or more permanent workers[138]. Except for one farmer who employs four permanent workers, both make use of additional day workers as well. The permanent workers are paid 750 Mts/month, 1,000 Mts/month and 50 Mts/day. Their availability is a mostly a matter of wage, as for instance showed by the next quote of an innovator who would like to employ permanent workers for the whole week rather than for the current two days.

> [FC]: I also seeded cabbage, but I won't transplant it because I have no workers. I need four full-time workers to work properly, but now I have none.
> [BvdP]: Can you not find them?
> [FC]: I don't find workers who I can pay 1,000-1,500 Mts per month, but only people who want 2,000 Mts. It is very difficult to pay that due to the price variations. If there is a stable price it's better because then you can see what you are going to earn.[139]

The quoted farmer is actually the one with the largest irrigated area in figure 12, even though he only employs someone for two days a week. Moreover, the figure shows that the third farmer with a permanent worker cultivates only a slightly larger irrigated area than some other farmers who only employ day workers. Hence, the availability of day workers implies that permanent workers are not an obligatory asset for a large irrigated field.

Temporary labourers

Both in the rainy and dry season the main labour demand is constituted by a small number of activities that need to be executed within short time, e.g. weeding or applying ammonium-nitrogen. Such peak labour demands can exceed available household labour and urge farmers to temporarily employ some day workers. Nine case study households make use of day workers for their irrigated production. The six farmers who do not employ temporary labourers for their maize do not employ workers for their irrigated crops either[140]. Three farmers who do not employ day workers are marginal farmers who only cultivate small fields due to a lack of

[138] One innovator has four permanent workers for five days a week, another innovator has two permanent workers for two days a week, and one land renting tomato producer has one permanent worker for five days a week.
[139] Field notes 07/10/11
[140] Next to those 15 farmers, there are three farmers who do not produce irrigated crops and one farmer who uses his four permanent workers only. One farmer who does use day workers for his maize production; does not do so for his cash crop production.

money to buy inputs. Obviously, those farmers also lack money to pay for workers, as for instance illustrated by a marginal farmer who explained me that he only employs workers after a good maize harvest.

> [LC]: If I harvest 75 bags I will keep it so that I can give it to people who can weed my maize field […] I use workers then so that I have more time to work on my *giri giri* field myself.[141]

The usual wage for one day is 50 Mts pp., however some workers who get paid per field sometimes manage to double this amount. Many farmers also pay in maize bags, according to the wishes of the labourer. No farmer told me that he/she provides his workers with a piece of land.

Many farmers who do make use of day workers also point at the involved costs as a reason not to produce larger areas of cash crops. Both some innovators, intensive tomato producers and diversified farmers seem hesitating to spend more money on workers because this may affect their profit. The following quote from an intensive tomato producer using credit from his customer Joanna to buy inputs illustrates that farmers are not eager to borrow money to pay for labour.

> [BvdP]: Your irrigated field is always the same size from May till November. What makes that it's that size and not bigger?
> [TS]: I work on those fields because for me it's okay. Sometimes I cannot get money to pay people to work. Therefore I always grow the same size.
> [BvdP]: Can you not ask Joanna for money to pay a worker?
> [TS]: It's a good idea, but the problem is that I will have less profit since I need to pay back that money.[142]

Nevertheless, not making use of temporary labourers does not necessarily imply a smaller production system. One innovator, intensive tomato producer and land renting tomato producer have average sized irrigated fields[143], but still do not employ temporary workers. The land renting tomato producer invites friends to help him and later gives them a small part of his harvest; whereas the intensive tomato producer collaborates with his neighbour during activities with peak labour demand. Both of them do not spread the planting of their fields in order to divide the labour demand of peak activities. Hence, social capital can be used to overcome elevated labour demands without having to employ workers. The innovator decreases his labour demand by using sprinkler irrigation, which I will explain below.

Productive assets

Kalinda et al. (2000) explain that in Northern Mozambique the number of oxen owned by a farmer is a main determinant of his/her agricultural productivity. In this research, the case study households who cultivate additional maize for sales during the rainy season possess relatively more cows as well. However, I do not know how many of those concern productive oxen that can actually be used for ploughing. Since two oxen are usually needed for one plough, the four farmers with fewer oxen can be expected to be negatively affected by that. They can also hire a worker with oxen though, which only results in a delay of the ploughing activities. Moreover, some farmers prepare the fields by using a hoe. The fact that some farmers with few cows cannot produce enough maize for their own consumption seems to be rather caused by a lack of land or money to pay labourers than by a lack of oxen.

While for the size of farmers' maize fields it is not probable that it depends on their number of oxen, it is definitely not determining for the size of their cash crop areas. The irrigated fields are much smaller than the maize fields that farmers cultivate with the same number of cows. Moreover, ploughing only takes about 6 person-days/ha, which is relatively little compared to the 208 person-days/ha that are needed for a total

[141] Field notes 03/10/11
[142] Field notes 29/11/11
[143] Respectively 0.3, 0.3 and 0.4 ha on average from May to November.

tomato cycle. Even if preparing the field by hoe, the labour demand constitutes a relatively small part of the total; according to Lukanu et al. (2007) about 30 person-days/ha.

The use of technology can also decrease the labour demand of a production system. The best example is the use of sprinkler irrigation, which takes away some of the labour demand of irrigation; an activity that takes on average 28 person-days/ha per tomato cycle but varies among different farmers from 12 to 63 person-days/ha. Another form of technology that one innovator is planning to purchase is a tractor, which he wants to use to cultivate rain-fed cash crops such as soya beans, *giri giri* and sunflowers during the rainy season. Though the use of sprinkler irrigation seems to be spreading slowly, the use of a tractor is clearly beyond the financial capacity of all other farmers I have met in the research area.

The role of labour in the differentiation of business strategies

Above I showed that differences in available household labour and the possession of oxen do not limit farmers' cash crop production in the dry season. The employment of permanent or temporary workers is not a prerequisite either for cultivating an irrigated area of up to 0.4 ha[144]. The fact that nearly all case study households cultivate less than that regardless of their business strategy[145] implies that for the dry season, the ability to pay for a worker does not determine a farmer's business strategy. Nevertheless, since either employing workers or using social capital or technology are necessary to realise the cultivation of a considerable irrigated area[146], the organisation of labour does shape the possible size of one's cash crop production.

For the rainy season this situation is different, since cash crop production competes for labour with the production of maize. The available household labour does not determine whether farmers can produce cash crops beyond their maize production, and neither does the amount of oxen. All farmers who produce more than maize for consumption during the rainy season employ workers to support them during peak labour activities. The diversified farmers and intensive tomato producers use most of that labour to produce maize for sales. However, the innovators rather use it to produce extra cash crops. The fact that all those farmers employ workers in that period no matter their crop choice, indicates that the decision to grow extra maize or cash crops is not a matter of the organisation of labour. Rather, it is the consequence of the different logics behind the three business strategies, e.g. with respect to innovation and risk management (see chapter 5.2 and 5.3).

Hence, the organisation of labour does not play a major role in the differentiation of business strategies, even though it can play a role in determining the size of one's cultivated area. Only in the few cases when household labour is affected by disease or a high age, farmers can be forced into marginality. The possession of oxen is not a prerequisite for cash crop production or the execution of a particular business strategy either. A combination of a lack of money to pay a worker and a lack of social capital or technology to compensate for that can limit the size of one's cultivated area, but not up to the current irrigated field sizes of the marginal farmers. Hence, the organisation of paid labour does not affect farmers' business strategies either.

[144] One farmer produces 0.4 ha of tomatoes without employing workers, which is an area that most farmers do not even reach (see figure 12). However, even if the production is spread out in time, an irrigated area larger than that does require the employment of a temporary or permanent worker, since labour demand will then exceed the time span of a tomato cycle.

[145] Except for two innovators with average irrigated areas of 0.8 and 2.1 ha and one land renting tomato producer with an average of 0.5 ha.

[146] Except for the marginal farmers, all farmers cultivate at least 0.2 ha of irrigated crops in the dry season.

6 The impact of farmers' business strategies on irrigation system dynamics

Water distribution in farmer-managed irrigation furrows in Southern Africa has been characterised by different modes of organisation. Coward (1986) elaborated the concept of hydraulic property to describe that a contribution to the construction and maintenance of a canal plays an important role in water distribution dynamics among farmers. Bolding et al. (2009) explain that in the east of the Manica district[147] water distribution results predominantly from farmers' hydraulic position within the scheme, and that farmers use a variety of arguments to claim some authority over the management and maintenance of the canal (see chapter 2).

Findings of this research suggest that in a relatively more water abundant area like Messica, irrigation system dynamics are rather shaped by the business strategies of the farmers who make use of the system. The water requirements of a farmer's production system determine whether a farmer actually uses his/her status of *dono do canal* or his/her hydraulic position[148] to exert control over water distribution. Moreover, water abundance allows most farmers to irrigate sufficiently without having to exert control over water distribution. Maintenance activities in the researched irrigation systems are organised by the farmer who is most in need of an elevated flow discharge, and not necessarily by the *dono do canal*. Nevertheless, unless the *dono do canal* is a marginal farmer, he is the one with most control over water distribution and the planning of maintenance activities. Hence, the business strategy of the *dono do canal* plays a very determining role in the irrigation system dynamics. For each of the five researched irrigation systems I will now briefly explain its main features and then focus on the ways different farmers in the system have organised their water distribution. After that I will discuss the implications of the fact that farmers have different business strategies on water distribution and maintenance, and conclude with an explanation of the specific role that the *dono do canal* plays in this.

6.1 The Ruaca 7 irrigation system

The Ruaca 7 irrigation system is situated downstream at the Ruaca river. The system counts seven users and has a relatively high discharge[149]. Figure 13 shows the irrigated areas in October of three case study households I visited, from up to downstream respectively a diversified farmer, a marginal farmer and an innovator. The diversified farmer cultivates 0.4 ha of predominantly beans and some tomatoes, the marginal farmer grows many crops on one field, including okra, onions and tomatoes. The innovator has 1.4 ha of tomatoes and 2.9 ha of irrigated maize and okra. The maize and okra are only irrigated once a week, whereas all other crops are irrigated twice a week.

[147] They refer specifically to irrigation furrows in the upper Revue river.

[148] Or other assets such as one's social network (Nkoka, 2011) or claims based on investment, seniority, production, responsible leadership, sharing or courts (Bolding et al., 2009).

[149] In the head of the system it takes about 12 hours to irrigate one ha, and in the tail-end about 26 hours. The average in the research area when the complete water flow is used is 25 hours/ha.

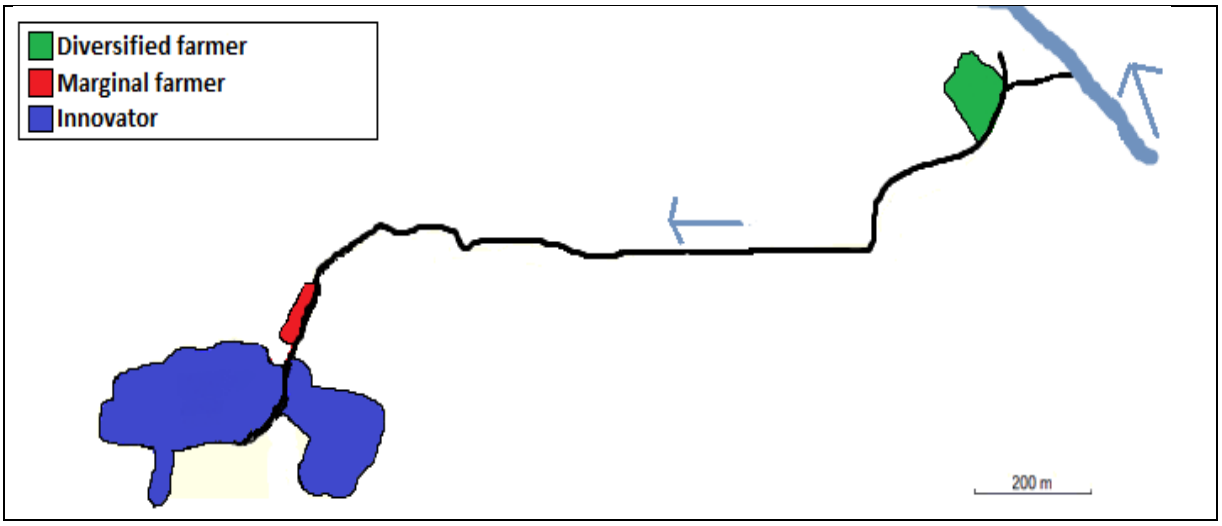

Figure 13 The Ruaca 7 canal with the irrigated area in October of three case study households

The innovator constructed the complete canal system in 1994 using his experience with irrigation in the Rotanda and Chadzuca areas. As a consequence, the other users consider him as the *dono do canal*. He gave other farmers who started living in between the intake and his field permission to use the water as well[150], but he maintains the first right of use. He can irrigate from Monday to Saturday until 16.00, and the other farmers are allowed to irrigate after 16.00 and on Sunday. The other users have set up a distribution schedule for this by themselves, and assigned to each farmer one fixed day and a part of the Sunday.

The *dono do canal* deliberately refused other users to compensate him for their water use, as he explained in the following quote. He just wants them to contribute to repairs and the half-yearly cleaning of the canal.

> [FC]: I did not ask them to pay for the canal, since then they would say: 'we paid so we can use water whenever we want'.[151]

The *dono do canal* states that he does not allow the other users to use water beyond their time since they irrigate small places only. The next quote shows that when the other users make a claim to ask for more water, he will compensate them in another way.

> [FC]: Sometimes they say: 'I worked one day so I can irrigate all the time'. But then I will tell them that it's not possible and that I will pay them if they worked on the canal because of that.[152]

In this way the *dono do canal* prevents hydraulic property creation by other farmers in the system, in order to maintain his control over water distribution and to ensure the water availability needed for his large production system.

Since she cannot change the irrigation schedule, the diversified farmer compensates for the short time by irrigating at night. This takes relatively short, since the flow discharge is very high upstream. The marginal farmer indicated he cannot do that because he is an old man that needs to rest. Moreover, it would take longer since the flow discharge is lower downstream. On top of that, with the current distribution schedule he can basically only irrigate his crops once a week, which is a problem for his tomatoes[153]. As a consequence, the marginal farmer faces water shortage whereas the diversified farmer does not.

[150] He does not allow them to rent out their fields to other farmers though.
[151] Field notes 10/11/11
[152] Field notes 07/10/11
[153] His assigned day is Saturday after 16.00, which is not very useful since he can also irrigate the whole Sunday.

Currently, the *dono do canal* also faces water shortage since the canal broke down due to heavy flow discharges earlier this year. As a consequence all users of the system did not irrigate for four months. The other users expect the *dono do canal* to initiate repairs, both because he is the owner and the main user of the canal. In the end the users repaired the canal together, but only after the *dono do canal* had arranged some tree stems and in a later stage plastic tubes. He did not ask other users to pay for it since that would take too long. Both after the first and second reparation the water flow was still less than it used to be, and as a consequence the *dono do canal* still cultivates a smaller irrigated area than before. The other users did not experience problems anymore, because their fields are smaller.

In short, the *dono do canal* uses his investments in the construction and maintenance of the canal as an argument to stay in control over the water distribution in the system. Since the other farmers do not have the urge, permission and capital to do so, they have to deal with the distribution schedule set up by the *dono do canal*. The diversified farmer deals with this by irrigating at night, but the marginal farmer cannot do this due to his limited labour capacity. He claimed to me that he has the right to use more water, and that otherwise he will stop contributing to the cleaning of the canal. However, since both the diversified and marginal farmer indicated that they lack the money and time to cultivate a larger irrigated area than they currently do, they do not really try to change the actual distribution schedule.

6.2 The Godi 9 irrigation system

The Godi 9 irrigation system is situated relatively downstream at the intensively used Godi river. The system counts 11 users although at the moment of fieldwork only about 7 of them use the water. Upstream the flow discharge is still high but for downstream users the discharge is very low[154]. The number of downstream users has increased considerably over the last years, and also include some villagers who use the water for making bricks. Figure 14 shows the location of the four case study households; from head to tail end respectively a marginal farmer, two diversified farmers and a land renting tomato producer. The upstream diversified farmer cultivates 0.4 ha of beans and tomatoes in October, and the marginal farmer does not irrigate at all. The land renting tomato producer grows 0.4 ha of tomatoes and some cabbage. The fields of the downstream diversified farmer have not been measured.

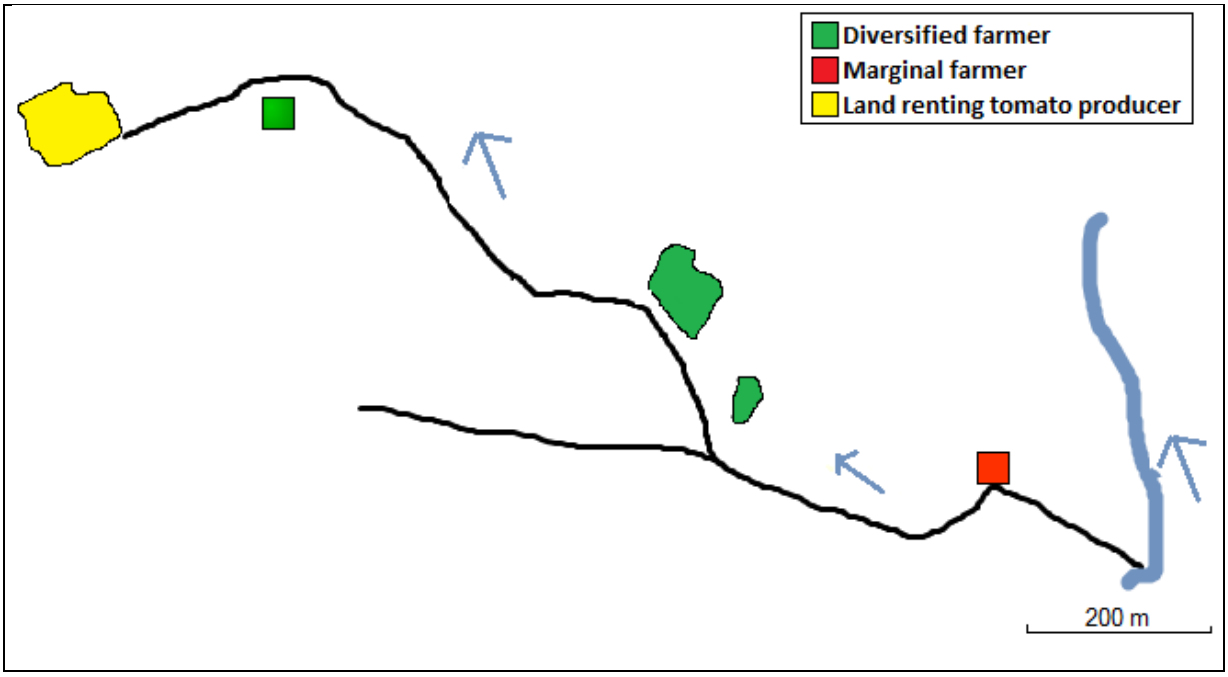

Figure 14 The Godi 9 canal and the irrigated area in October of its four case study households

[154] Upstream it takes a farmer about 12 hours to irrigate one ha, whereas downstream it takes 53 hours. Even though in case of the latter two farmers irrigate at the same time, it shows that the flow discharge is still considerably lower.

The marginal farmer indicated by a red square does not irrigate at all, and the fields of the diversified farmer indicated by the green square have not been measured.

The *dono do canal* is currently a marginal farmer who does not irrigate. He constructed the system in 1998, and in the same year the canal was lengthened by the upstream diversified farmer and some others. A group of farmers including the downstream diversified farmer constructed the large northern sub canal in 2007, and paid 150 Mts each to the *dono do canal* to thank him[155]. The land renting tomato producer is renting the field during the dry season since this year[156]. He explained me that the farmers had actually bought the canal from the *dono do canal*, and one other young downstream user also told me that there is no real *dono do canal*. Nevertheless, older farmers both up- and downstream still view the currently marginal farmer as the *dono do canal*. Hence, ownership of the canal is a debated issue among different farmers.

Each year in the rainy season the intake breaks through and the farmers that irrigate all contribute to the purchase of new sand bags[157]. In the following quote a diversified farmer who currently produces only little since he was ill explains that he keeps on contributing so that the canal will be in a good state when he will start using it again.

> [BvdP]: Is there a difference in contribution between people with big and small fields?
> [JC]: Everyone contributes the same amount of bags.
> [BvdP]: Do you think this is right?
> [JC]: For me it's not a problem, because there is more money if everyone contributes the same amount. Since last year, water is losing and therefore there is less water in the canal. Next year we want to fix it so that there will be more water again.[158]

Next to that all farmers, including the ones that do not irrigate currently, contribute physically to reparations and the 2-3 yearly cleanings from the intake until their own field. The following quote shows that the *dono do canal* participates in the maintenance of the intake in order not to lose hydraulic property of the canal, even though he is currently not involved in irrigated agriculture. Since he only has little capital at the moment he does not contribute money.

> [BvdP]: Why do you have to help if you are not using the water?
> [LC]: I help because I also have the plan to use water some time.
> [BvdP]: Do you do so in order to avoid problems with the other users or do you want to make sure that the canal is still in a good state?
> [LC]: I contribute in order not to have problems with the other users if I want to start irrigating again. I did not spend money on the bags and I want to compensate for that.[159]

The other farmers do not have a problem with that because he does not irrigate currently. To stop the need for annual reparations of the intake, some farmers want to invest in a cement intake. However, they expect that it will take a long time because they need to convince all users to contribute to its payment. In this respect it should be noted that this system lacks a user who cultivates considerably larger areas than the other farmers, like in the Ruaca system described above.

The farmers established a rotation schedule but since upstream farmers, including the *dono do canal*, do not always obey it most farmers just irrigate whenever there is water. In the following quote one of the

[155] One farmer explained that it is a tradition to pay part of the first harvest when someone did something good to you.
[156] He rents it from a friend, whom he does not have to pay. They only agreed that he had to use fertiliser, so that the owner could benefit from it when he cultivates maize on that field in the rainy season.
[157] All seven farmers yearly buy three bags of 15 Mts each.
[158] Field notes 06/10/11
[159] Field notes 03/10/11

downstream users explains that he does not like the irregular distribution, but due to his hydraulic position he cannot control this.

> [MB]: The people upstream do not use proper days, but take water whenever they want.
> [BvdP]: How do you feel about that?
> [MB]: *(after some hesitation*) The people down here are not happy with that. Sometimes we go there to discuss it, but they tell us that we must wait for them to finish. I just wait, because there is nothing to do about it.[160]

The quoted farmer deals with periodic water shortage by irrigating at night or on any day when there is water, and in this way he manages to irrigate a big field. The two diversified farmers are situated less downstream in the scheme, but still they indicated that they usually grow a smaller field from September to November due to water shortage. However, water shortage is not the only reason they provided for that[161]. Despite the claims of some downstream users, the hydraulic position and position of *dono do canal* implied that the marginal farmer could irrigate whenever he wanted, at the time when he was still irrigating.

In short this system is characterised by a low flow discharge and irregular water use by upstream users that affect the tail end. Nevertheless, with respect to the four case study households the size of the irrigated fields actually increases from up to downstream, since downstream users anticipate on water flows in the afternoon or at night. Hence, though upstream users would be able to benefit from their hydraulic position and the position of *dono do canal* or a well-developed social relation with him, the downstream users actually manage to irrigate larger areas. They have not successfully used claims referring to hydraulic property to change the current distribution, even though they constructed their own part of the canal and they invest more money in the maintenance of the canal than the *dono do canal*. Rather, they use the water whenever they see it passing by. So, the ability to exert control on water distribution in this system is dominated by farmers' hydraulic position, but in this situation of relative water abundance the water use of individual farmers is rather the result of their business strategy.

6.3 The Chirodzo 4 irrigation system

The Chirodzo 4 system is located midstream of the Chirodzo river and counts 10 users. It consists of two canals with an own intake that are interconnected from August to December. The estimated flow discharge is near the average in the area and the differences between up and downstream are relatively small[162]. The northern canal is used by 6 households from one family and includes an intensive tomato producer who is situated relatively downstream and cultivates 0.3 ha of tomatoes in October. The southern canal serves from up to downstream a land renting tomato producer growing 0.5 ha of tomatoes, a marginal farmer with 0.1 ha of predominantly cabbage, a non-classified farmer with 0.1 ha of tomatoes and one more farmer who was not included in the case study households. The canal system is shown in figure 15.

[160] Field notes 30/09/11

[161] One farmer indicated that he has no money for inputs in that period because he needs to buy maize from then onwards. Furthermore, the fact that they only plant tomatoes after the peak season indicates that it is probably also a decision to benefit from higher prices.

[162] The time to irrigate one ha is about 33 hours for the intensive tomato producer, 25 hours for the land renting tomato producer and 39 hours for the non-classified farmer. Nevertheless, flow measurements executed by Krüger (2011) indicate an average discharge of 3.3 l/s for the intensive tomato producer and of 2.3 l/s for the land renting tomato producer. The fact that the intensive tomato producer faces a higher discharge but still irrigates longer may be caused by the different distribution features of the two canals. The intensive producer can only irrigate with intervals of 5 days, whereas the peak season producer usually uses intervals of 4 days. Moreover, the latter can irrigate whenever he wants whereas the other has to stick to a rotation schedule.

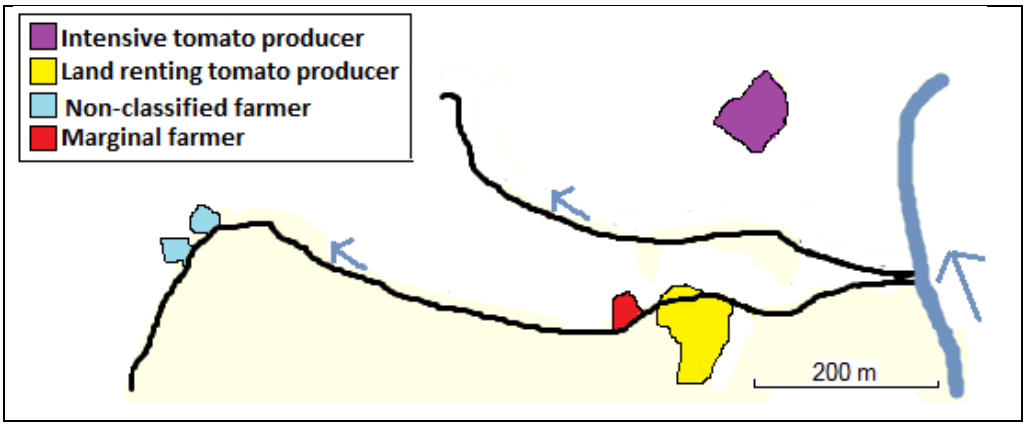

Figure 15 The Chirodzo 4 system with the irrigated area in October of four case study households

The southern canal had been constructed by the husband of the marginal farmer. Her son, who still lives at the farm, is now considered to be the *dono do canal* of that canal. The case study household farmer who has not been classified connected himself to the canal later. The land renting tomato producer rents his field in this system from the marginal farmer. The *dono do canal* of the northern canal does not live here anymore. The family of the intensive tomato producer moved to the canal right after its construction, and are currently the only users that are left.

The land renting tomato producer can decide himself when he wants to irrigate, and if another farmer wants to use the water he will just wait for a while. Because of this, other users do not complain about the fact that he uses a lot of water for a field he is renting, as for instance showed by the following quote.

> [BvdP]: Do other users of the irrigation system not complain that you rent and use a lot of water?
> [JS]: There is no problem. They don't complain because if they want to use water I just stop irrigating.[163]

The *dono do canal* irrigates twice a week on fixed days. The non-classified farmer just irrigates whenever the other users are finished and let the water flow down the canal. In the northern canal they have a fixed rotation schedule with an interval of 5 days. Everyone sticks to the schedule, which may be caused by the fact that they all belong to one family and have an interest to maintain good relations beyond those of water users in the same irrigation system.

The connection between the two canals is subject of discussion among the farmers[164]. The current *dono do canal* argues that the southern canal is theirs and therefore he closes the connection sometimes, leading to a decreased discharge in the northern canal. During an interview I observed that right after the connection had been closed and the water flow diminished, the irrigating user of the northern canal sent his wife to open it again. The *dono do canal* does not close the connection because he needs the water for his field, but rather because he feels that he is the owner and that he should be able to use water whenever he wants for whatever activity. The fact that the other user kept on opening the connection each time it was closed, indicates that he does not recognise the authority of the *dono do canal*.

It would be interesting to assess whether the maintenance of the southern canal is organised by the *dono do canal* or rather by the land renting producer, who is the only user of the southern canal who cultivates a

[163] Field notes 25/11/11

[164] The northern canal was built first. Later, in 1975, the southern canal was constructed right upstream the intake of the northern canal by the husband of the current marginal farmer. In order to compensate the farmers of the northern canal for the consequentially decreased discharge he allowed them to connect the two canals during the driest period. Since the owner passed away his son started to make problems and closes the connection every now and then.

considerable irrigated field. Unfortunately, I do not have that information. The northern canal is maintained by its own users, but I do not know whether they also participate in the maintenance of the southern intake.

The peak season producer and the non-classified farmer have irrigated fields in another canal system as well. They are respectively the same size and much bigger as their irrigated fields in this system. The peak season producer looked for a field to rent because he could not plant tomatoes twice a year on his other field[165]. He once told me that water shortage was the reason why he had not planted beans this year, but later it appeared that actually he had no money for the inputs[166]. The non-classified farmer used to have not enough land to cultivate a big field in this canal system. Since his other field could be connected to a canal earlier this year he expanded his cultivated area enormously. The *dono do canal* does not face any water shortage. The intensive tomato producer also indicated that water shortage is not a problem, since he can irrigate at night or early in the morning if he wants to irrigate more.

In short, water distribution in the northern and southern canal can be characterised by very different organisational modes, both as a consequence of the farmers' business strategies and their social relations. In the southern canal, the only big user can irrigate as much as he wants, since the other users only need little water. This is a consequence of respectively their business strategy and limited land size in this system. The fact that he rents from the *dono do canal* who is his cousin may also contribute to this. In the northern canal all six users cultivate a considerable irrigated field, and therefore such an irregular distribution would be inconvenient. The completely equal distribution schedule that characterises this canal would probably not exist when water was claimed on basis of one's hydraulic position or hydraulic property. Nevertheless, their relation as family members has probably allowed for such a distribution.

6.4 The Nhamaguere 1 and 3 irrigation system

The Nhamaguere 1 and 3 system consists of two connected canals situated in the upstream part of the Nhamaguere river. Both canals have a high flow discharge[167]. In October, system 1 is used by one marginal farmer upstream growing 0.02 ha of tomatoes and an innovator irrigating 0.3 ha of tomatoes by sprinkler irrigation[168]. Downstream, four brothers of the innovator make use of the canal as well. The upstream part of system 3 is used by five households from that same family, and the downstream part by about four other users.[169] The downstream users include one intensive tomato producer and a land renting tomato producer, both cultivating about 0.3 ha of tomatoes. The two canals are depicted in figure 16.

[165] This is a way of pest management that all farmers seem to apply.

[166] Sometimes I got the impression that water shortage was mentioned as a socially more acceptable answer on my questions than a lack of money. When continuing on the subject, if often appeared that a lack of money to buy inputs was the major reason for not having cultivated a particular field.

[167] Regarding system 1, the marginal farmer could not tell me the exact time he needs to irrigate his field. Anyways it would not have been accurate, since the field is very small and steep. The innovator needs 23 hours for one ha; but he only uses a small part of the total flow because of his sprinkler system. For system 3, the most downstream users only need about 15 hours to irrigate one ha.

[168] He started using sprinkler irrigation in 2008, after having started irrigated production in 2007. He shifted from furrow to sprinkler irrigation because furrow irrigation takes a lot of time.

[169] The exact number of users varies throughout the year.

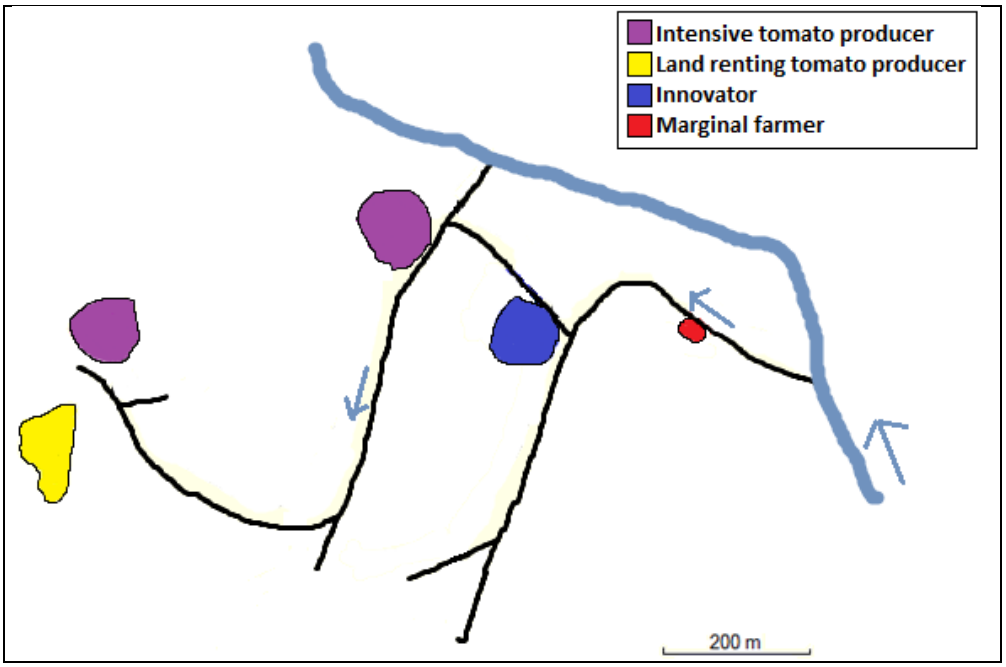

Figure 16 The canals Nhamaguere 1 and 3, respectively situated right and left, with the irrigated area in October of five farmers

The image contains GPS measured areas of the four case study households in this system and an estimation of the irrigated area of the dono do canal of the Nhamaguere 3 canal.

The *dono do canal* who is situated upstream and constructed the intake of canal 1 is currently a marginal farmer. The other users arrived later and lengthened the canal up to their fields. The farmers from that family organise the maintenance of the canal when the water flow decreases, and sometimes the *dono do canal* helps them. The *dono do canal* who constructed canal 3 is a member of the same large family. The downstream users connected themselves to the canal later. The land renting and intensive tomato producers are both renting the fields in this system[170]. The maintenance of this canal is done by all current users. The downstream intensive producer and the innovator have irrigated fields within other canal systems as well, both in their own possession.

The *dono of canal* 1 indicated that he can irrigate whenever he wants, both because he constructed the intake and because he only has a small field. The innovator can do the same, because the discharge requirement of his sprinkler system is much lower than that of furrow irrigation. Since I did not study any other case study households in this canal, I do not know the distribution features by the downstream users of this canal. Regarding canal 3 the *dono do canal* set up a rotation schedule with fixed days and times for everyone according to the size of their field. Both his hydraulic position and position of *dono do canal* imply that he is the one who decides about the schedule. This is both indicated by other farmers who could not change the schedule and by himself in the following quote.

> [BvdP]: What do you do if some of the other users want to irrigate a bigger field?
> [FS]: They should ask me before in order to see whether this is possible. I will then tell them how big their field can be.[171]

According to the land renting producer the upstream farmers do not always obey this schedule, even when he goes there to complain about it. Since those users are all situated upstream, and moreover they are family members of the *dono do canal*, he does not have much power to change this.

[170] They only rent the fields during the hot season and without having to pay. One uses the field of his father, and the other one the field from a friend. The latter had to clear the field himself first, as a compensation.
[171] Field notes 02/11/11

The intensive tomato producer, who is the most downstream user of canal 3, asked the upstream farmers to let the water flow down after they finished. Since the *dono do canal* is the only upstream farmer who cultivates a large irrigated field, there are many days on which water remains for the intensive producer to irrigate his fields. The fact that the intensive producer experiences less water availability problems than the land renting producer is probably due to the fact that he can merge the water for some of his fields with water from a small other canal[172]. Next to that, with his two wives he has sufficient labour to be able to use the complete water flow of this irrigation system, whereas the land renting producer only has one wife who can help him to irrigate[173]. On top of that, during the driest months the intensive producer grows a major part of his production on a field that makes use of a different canal.

Summarising, the two case study households using canal 1 can both irrigate without having to consider the canal's distribution schedule. As the most upstream farmer, the *dono do canal* can use the little water he needs whenever he wants. Since he only irrigates small fields he leaves the organisation of the maintenance to the downstream farmers, whose production systems require a higher discharge than he does. So, the fact that the *dono do canal* only plays a minor role in the water distribution and maintenance of this canal is mainly a consequence of his marginal business strategy. The same is true for the other upstream farmer, who needs less water because of his innovative business strategy to use sprinkler irrigation.

In canal 3 the irrigation system dynamics are largely determined by the *dono do canal*, whose power to control water distribution is based on both his position as constructer of the canal and his hydraulic position of most upstream user. Since he irrigates a large field it is in his interest to use this power, contrary to the *dono do canal* of canal 1. The downstream users cannot control water distribution in the canal, but since they make use of the water that upstream farmers do not need as a consequence of their relatively small fields, they manage to cultivate considerable irrigated fields. The downstream intensive producer deliberately asked upstream farmers to do so, in order to assure himself a better water distribution.

6.5 The downstream Nhamazoma2 and Nhamanuchi irrigation systems

The sampled downstream Nhamazoma2 and Nhamanuchi irrigation systems concern four canals that are predominantly used by single users. The canals are located close to each other, but function independently[174]. The flow discharge is for all sampled farmers near the average in the area[175]. Canal 8 of the Nhamazoma2 river (see figure 17) used to be employed by an innovator and marginal farmer, but its intake is currently broken. Canal 9 and 10 of that river are only used by that same innovator; in October for irrigating about 1 ha of predominantly tomatoes. Canal Nhamanuchi 3 is used by another innovator who cultivates 0.2 ha of beans. Most of the time he is the only user, but there are three other farmers with small fields who sometimes make use of it as well. Canal Nhamanuchi 5 is used by an intensive tomato producer only, who grows 0.2 ha of mainly tomatoes and some cabbage.

[172] This canal is not connected to a river, but it may catch water that flows down from farmers upstream; see figure 17.
[173] In order to handle the complete flow discharge of this canal, three people are needed.
[174] The particular farmers have been selected based on a presumed collaboration in marketing rather than on their interactions as canal users.
[175] The innovator using the downstream canals of the Nhamazoma2 river needs about 26 hours to irrigate one ha. The innovator and intensive tomato producer who use the Nhamanuchi river need respectively about 28 and 22 hours/ha.

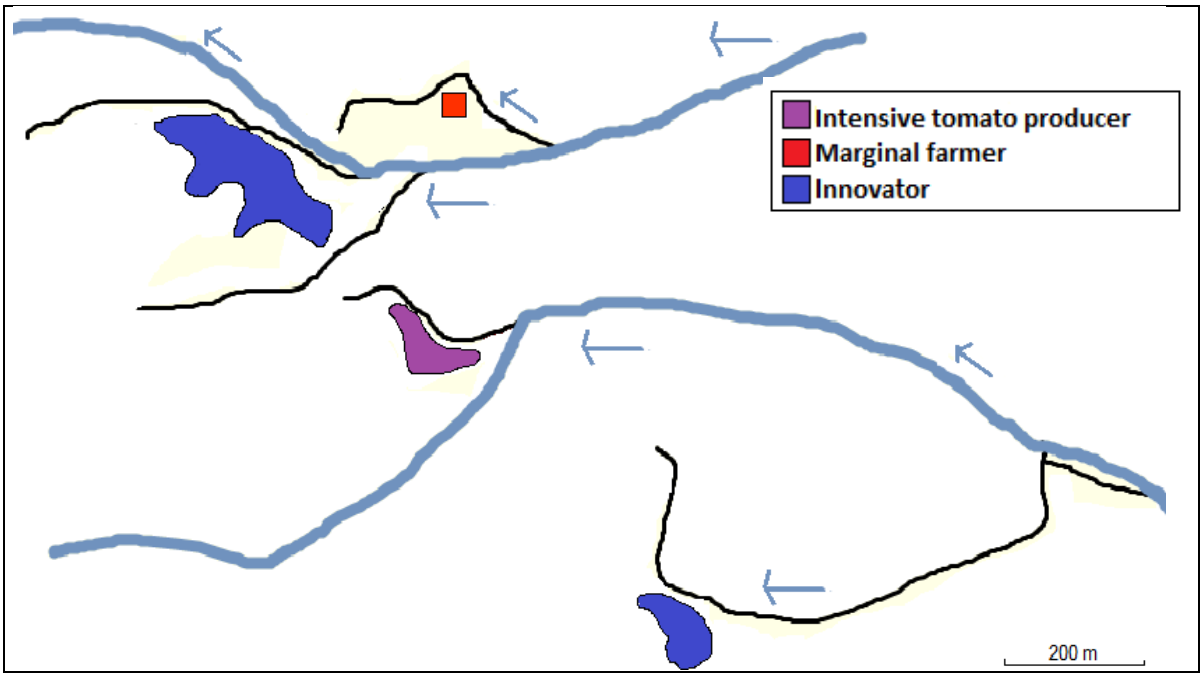

Figure 17 The downstream Nhamazoma2 and Nhamanuchi systems with the irrigated area in October of four case study households

From right to left, the upper three canals depict respectively canal 8, 9 and 10 of the Nhamazoma2 river. The two lower canals concern the systems Nhamanuchi 3 and 5. The red square indicates a marginal farmer who does not irrigate currently.

The innovator using the canals in the Nhamazoma2 river constructed the two downstream canals himself. Both he and the marginal farmer claim to have constructed the currently broken intake[176]. Since the innovator cultivates some pretty large irrigated fields but the marginal farmer does not want to be restricted in his water use by that, the farmers are in conflict until today[177]. Since the innovator uses his permanent workers to irrigate he is not totally flexible in its timing, as for instance showed by the following quote.

> [BvdP]: When do you irrigate your crops?
> [TJ]: I irrigate each field twice a week, for example on Monday and Friday. I do not have fixed days for irrigation, because sometimes my workers are not there.[178]

While they used to maintain the canal together, now no one has repaired the intake because the innovator can use his other canals and the marginal farmer did not have money for inputs this year.

The other innovator, who makes use of the Nhamanuchi 3 canal, bought his field along the canal when it was already constructed. The *dono do canal* only uses it during the rainy season because he makes use of other canals as well, and he only cultivates a small irrigated field[179]. The other users have very small fields as well, so the innovator can basically irrigate all the time. The *dono do canal* explained that all users contribute to the

[176] The innovator said he constructed the canal in 1975, whereas the marginal farmer told me that he was the one who constructed it, but in 1995. Since the innovator shifts his fields and the use of his different canals each year, it may be the case that the marginal farmer rehabilitated the intake when the innovator was not using it, and therefore considers himself as the *dono do canal*.

[177] The innovator accuses the marginal farmer for spoiling water after finishing his irrigation, and the marginal farmer accuses the innovator for using water all the time, not leaving time for him to irrigate. Since the marginal farmer is situated upstream he can just use the water whenever he wants to, but the innovator lives nearby and will make a problem if that happens. Both told me they had involved the ministry of agriculture and the headman to solve the problem, however its success only lasted little time. The marginal farmer told me that the currently broken intake was not destroyed naturally, but that the innovator had done this.

[178] Field notes 28/10/11

[179] The total of his irrigated fields in October was only 0.08 ha.

maintenance of the canal. The intensive tomato producer using canal 5 constructed the canal himself and is its only user.

In short, the relatively flat topography in this area has allowed for the construction of many canals, each with its own dynamics. As a consequence, most canals are used by only one farmer, and some farmers even possess several canals. None of the farmers I talked to in the downstream Nhamazoma2 and Nhamanuchi systems is currently constraint by water availability, as their water use is only the result of their own business strategy. The two innovators are planning to install sprinkler irrigation, but this is mostly in order to spend less time irrigating. The heavy and inflexible water demand of a large innovator has contributed to a conflict, which possibly caused the rupture of an intake. It has not been repaired yet since the only current user is a marginal farmer. In another canal the *dono do canal* only cultivates a small field and therefore he does not restrict the other users from using water in any way. Hence, in all canals distribution and maintenance are predominantly determined by the activities of its single users.

6.6 Irrigation system dynamics as a result of farmers' business strategies

In this paragraph I will use the characteristics of the described irrigation systems to explain the role of farmers' business strategies in the irrigation system dynamics. The fact that water is relatively abundant in the research area implies that it does not constrain farmers to realise their production. Therefore, water distribution in the canal systems is mainly shaped by the requirements of farmers' business strategies. Maintenance activities are organised by the farmers who are most in need of a sufficient flow discharge. The *dono do canal* has most control over both distribution and maintenance, but he only uses this power when this is necessary to assure his own water demand. Hence, his business strategy is of particular importance for the irrigation system dynamics.

The area is relatively water abundant

Water availability in the research area is only a constraining factor for those case study households who have no access to irrigable land, either temporary or permanently. Farmers who have a considerable irrigable field connected to a canal system and who have the financial and human means to realise a certain business strategy usually find a way to bring about the necessary water use[180]. This indicates that the area is relatively water abundant. The fact that all business strategies are spread throughout the different irrigation systems and the different physical positions within those systems confirms that water availability has not played a major role in determining farmers' production and water use. Moreover, the peak production period of both tomatoes and the total of all irrigated crops actually takes place just before the rainy season, when flow discharges are the lowest[181].

In chapter 2 I explained that Bolding et al. (2009), who did research in farmer-managed irrigation systems in a nearby area, found that water can be characterised as a scarce resource that farmers need to control. I will now show that the more water abundant situation in the research area has led to different social patterns of water distribution than in a situation of water scarcity.

Water distribution is shaped by the requirements of farmers' business strategies

Chapter 4 and the paragraphs discussed above in this chapter show that farmers with different business strategies have different requirements on both the quantity, i.e. the available irrigation time and flow discharge, and timing of water availability. This has an impact on the control they exert over water distribution and their commitment to the maintenance of the canal. There is no major difference in the irrigated areas of diversified farmers, intensive and land renting tomato producers, and some innovators. The fact that two innovators irrigate much larger areas and that marginal farmers, sprinkler irrigators and farmers who recently

[180] This is based on farmers' water use in the dry season. However, during the rainy season water will be even less constraining, since there is more water available and less farmers irrigate in that period.

[181] I do not know whether the low flow discharge is due to a natural phenomenon or the result of the intensive water use; but anyways it characterises the water availability that the individual farmers face in that period.

faced a shock event use much less water implies that those categories have different requirements with respect to water quantity. Concerning the time period of water use, most farmers irrigate during the whole year, except for the land renting tomato producers and some marginal farmers. Next to this, most farmers are flexible in the exact timing of their irrigation since they usually irrigate themselves, but the big innovators whose workers irrigate need to use water on specific days and times.

Farmers' business strategies determine the extent to which they try to control water distribution within the scheme. The various *donos do canal* who irrigate considerable areas deliberately stay in charge over the distribution schedule, whereas the marginal *donos do canal* leave water distribution up to the other users. Two of them can do so because their hydraulic position is upstream, but the other two are contested on this aspect by other farmers, as I will explain below. The *dono do canal* of the Ruaca7 system has strong requirements on both the quantity and timing of water availability because he uses his workers to irrigate a very large field. Since on top of that he is situated downstream, he strategically controls water distribution in the canal by not allowing other users to invest in the canal and so reserving the creation of hydraulic property to himself. Hence, both the business strategy and the hydraulic position of the *dono do canal* determine to what extent he exerts his control on water distribution in the canal.

The other users in the canals usually found different ways to fulfil their water requirements, without having to control water distribution. When the distribution schedule does not satisfy their water demands[182], most of them either irrigate at night or wait for water flowing down from upstream farmers who do not need much time to irrigate[183]. This strategy also works during the most water scarce period, regardless of farmers' hydraulic position. One farmer uses sprinkler irrigation that decreases his water requirement, and other farmers are single users of a canal which implies continuous access to water. Users who belong to one family make use of that to assure the water distribution they need, and one farmer probably used his social contacts to ask upstream farmers to let the water flow down to his farm after they finished. Hence, the water abundant situation allows farmers to satisfy their water requirements in a variety of ways without having to exert control over water distribution.

The farmers who need the canals most organise its maintenance

Farmers who need different quantities of water have different requirements on the irrigation infrastructure. Therefore, the initiative and commitment to the maintenance of the canal also differs among farmers according to the amount of water they use. I already discussed the *dono do canal* of the Ruaca7 system, who invests most in the maintenance of the canal because he cultivates the largest irrigated field and is situated downstream. Other *donos do canal* who cultivate a considerable irrigated field themselves, e.g. in the Nhamaguere3 or Nhamanuchi systems, are also the ones who organise the maintenance of the canal, by demanding all users to participate.

All other farmers who cultivate a considerable irrigated field seem to contribute without exception to the cleanings and reparations of the intake and canal. Even farmers who temporarily produce less due to a shock event still fully participate. Only marginal farmers, who structurally use the least amount of water, do not often fully contribute to the maintenance of the irrigation infrastructure. In three of the four systems where the *dono do canal* is a marginal farmer, other users organise the cleaning and reparations of the canal. Those cases concern respectively a system maintained by a family, a single user and a group of users without family ties[184]. It may not be surprising that in the latter system most disagreements exist about participation to the

[182] In most cases this happens from September to November, but for some farmers the official water distribution schedule is insufficient during the whole dry season.

[183] Though those farmers do not indicate water shortage as a constraint, their possibilities to expand are clearly more limited than farmers with full control.

[184] In respectively the Nhamaguere, Nhamazoma2 and Godi system.

maintenance, especially with respect to its payment[185]. In the system with a single marginal user, no one has repaired the broken intake yet. The marginal farmer who makes use of the Ruaca7 system also threats not to participate anymore.[186]

A *dono do canal's* business

Nkoka et al. (2011) explain that farmers' ownership of a canal is reflected by their access to and control of irrigation systems, and therefore distinguishes use and control rights. In the described irrigation systems farmers' water use rights, i.e. the right to access and use the water (Meinzen-Dick, 2000), are normally determined by the *dono do canal*. In case of a marginal *dono do canal* this is rather based on an agreement among the other users. The use right is usually maintained by contributing to the maintenance of the irrigation infrastructure. Even for the farmers who rent a field this was the only contribution they made to the other users[187]. The *donos do canal* also feel they have to contribute to this in order not to lose this right, as for instance shown by the quoted *dono do canal* in chapter 6.2.

Control rights, i.e. the right to control the management, exclusion and the alienation of rights concerning the irrigation system (ibid.), are normally reserved to the *dono do canal* only. In the Ruaca7 and Nhamaguere3 systems, the *donos do canal* are in full control of the distribution schedule, maintenance and exclusion to the irrigation system. Like I explained above, especially the downstream *dono do canal* strategically invests in hydraulic property creation in order to maintain this control. For the marginal *donos do canal* however, their control is currently affected by their business strategy. The upstream *donos do canal* in the Godi9 and Nhamaguere1 systems had let go their control over the water use, distribution and maintenance in the canal[188]. The fact that more and more users join the Godi9 system and that the distribution schedule is not respected may be a consequence of that[189]. As *dono do canal*, the marginal farmers in the Chirodzo4 and Nhamazoma2-8 canal do not want to be restricted in the timing and purpose of their water use. This has caused conflicts with the other users who reject using the water in the system for domestic use.

The marginal *donos do canal* have lost some control over the system because they do not need this to be able to fulfil the water requirements of their business strategy. However, the majority of the other users still view them as *dono do canal* since they have constructed the system. Once they want to increase their irrigated production again, there may be a renewed need to use their ownership to exert control over water distribution, maintenance, or even exclusion or the alienation of rights. Hence, whenever a marginal *dono do canal* manages to change his business strategy, this will either change or contest water distribution in the system. As long as he/she stays a marginal farmer, irrigation system dynamics result from the collaboration of other users, which has differing outcomes according to the social relations of those particular users.

[185] E.g. the farmer who currently cultivates the largest field wants all farmers to invest in a cement intake, but some other farmers do not want to pay for that.

[186] Krüger (2011) described that the marginal farmer who is the *dono do canal* of the Chirodzo4 system does initiate the maintenance of the canal. However, since in the year preceding her fieldwork he once cultivated a big field whereas during the fieldwork of this research he did not, I am not sure whether he also organises the maintenance when he only irrigates a small field.

[187] This does not include eventual compensations paid to the owner of the field they rent.

[188] The *dono do canal* of the Godi9 system said he is still in control of the water distribution, but especially the younger other users indicated they do not view him as the owner anymore.

[189] Like explained in chapter 6.4, the family ties of the users of the Nhamaguere1 system may account for the fact that such problems have not arisen in that system.

7. Conclusions and discussion

In chapter 3-6 I have answered the four sub questions of this research one by one, and I have now reached the point to answer the main research question:

How do different business strategies of irrigating smallholders in Chirodzo and Ruaca currently align to market opportunities and vice versa, and what is the impact of this difference in business strategies on irrigation system dynamics?

I will present my answer to this question in three statements, each informing a different field of interest. First, I will propose business strategies as a concept to explain the role of farmers' logic in the organisation of their farming practices, in order to get an understanding of the 'black box' that links farmers' assets and livelihood outcomes in the sustainable livelihoods framework. Secondly, I will use the case of Chirodzo and Ruaca as evidence to support a model for smallholder development that is based on the linkage of smallholder farmers to multiple-actor markets and the provision of supporting services to create the conditions that allow for farmer innovation and pro-poor development. Third, I will argue that irrigation system dynamics in Chirodzo and Ruaca differ from those described by other IWE studies in Eastern Mozambique, because water cannot be characterised as a scarce resource that farmers need to control, but rather as a relatively abundant resource that farmers use according to the requirements of their business strategy.

Business strategies as an alternative concept to explain farmers' livelihood outcomes

This research shows that farmers deal with market opportunities in a variety of ways, ranging from low input diverse production to intensive production of only tomatoes. The sustainable livelihoods framework states that different livelihood outcomes originate from differences in access to particular assets. However, access to assets alone does not explain the mechanisms by which farmers decide to use them. In this respect, the sustainable livelihoods framework leaves a kind of 'black box' in which the drivers of farmers' actions remain unexplained. In this research I introduced the concept of a business strategy to provide some insight into those mechanisms. A business strategy implies that there is a certain logic that characterises the whole range of farmers' activities. The fact that farmers in Chirodzo and Ruaca with similar production systems also practiced similar marketing activities indicates that we can indeed talk of such a particular organisation that characterises the complete range of farming activities, as was described as well by Veldwisch and Spoor (2008).

A closer look showed that the different business strategies could be characterised by a particular logic that informs farmers' decisions and to an important extent also shapes farmers' capacities to realise a certain strategy. To illustrate this, diversified farmers are characterised by a risk-averse logic as they minimise production costs and use their profit to buy cows. Innovators show a logic of more willingness to take a risk to make use of opportunities and use credit to purchase a sprinkler system or do other long-term investments. As a result of such differing logics, the two farmer types have also created different investment capacities which they use to realise their strategy.

I consider such different logics to be mainly determined by farmers' personality and skills. The possession of analytical skills to identify opportunities and disciplinary skills to re-invest profit accounts for different capacities to realise a particular business strategy. But a farmer's willingness to take a risk is more of a personality feature. The recognition of such personal differences among people is widespread in theory on human resource management, but is largely ignored in literature on smallholder development. In this respect this research does not merely add to the sustainable livelihoods framework, but also forms a critique to its narrow focus on assets to explain differentiation among farmers. Even so, it criticises the mainstream pro-poor market approaches (e.g. as described by Ruijter de Wildt et al., 2006), which view farmers' market engagement mainly as a direct result of the market institutions surrounding him/her.

The research outcomes rather provide evidence for the farming styles approach, which also recognises farmers' own agency to make decisions, and the fact that various viable options exist next to each other (Van der Ploeg et al., 2009). However, though farmers decide upon their own logic, Leeuwis (1993; in Van der Ploeg et al. 2009) explains that the strategic notions underlying a particular farming style are often discussed and shared within a farmer's network. I have noticed that some farmers who regularly sit together have the same ideas on farming, but others have not[190]. Since I acknowledge the possible role of farmers' social networks in their business strategies, further research would be important to create an in-depth understanding of that.

In order to fully understand a process of differentiation, this research also points at the need to analyse farmers' current individual drivers, and not limit the analysis to an explanation based on historic patterns. Nevertheless, since I am convinced that only a combination would create a full understanding of the driving mechanisms, I would recommend further research to look at farmers' business strategies from a historical perspective. A third perspective that has not been covered in this research is the role of intra-household relations. Though both men and women in Chirodzo and Ruaca work on cash crops, the business strategies presented in this research reflect predominantly a logic according to the male head of the household. Francis (1998) and Carney (1988) even warn that cash crop production increases the dependence of women on their husbands, as men are often in control of the resulting income. Therefore, to fully understand the mechanisms that drive decisions at household level it is essential to include an analysis of intra-household relations as well.

Hence, a multi-perspective analysis of farmers' business strategies can provide an understanding about the mechanisms that drive farmers' decisions, in order to open up the 'black box' contained by the sustainable livelihoods framework. Moreover, this approach would offer a research perspective that recognises farmers' own agency rather than viewing their livelihoods as a direct outcome of their assets and environment. I consider this perspective as a valuable alternative for the united use of the sustainable livelihoods framework and pro-poor market approaches that is currently promoted by various authors (e.g. Albu 2008; Johnson 2009; Owusu-Gyamfi 2009).

Chirodzo and Ruaca as a model for pro-poor development

Since the late 1990s the communities of Chirodzo and Ruaca have been developed from an area of subsistence agriculture into an important centre for commercialised tomato production. Smallholder farmers responded to the arrival of urban traders by expanding and intensifying their production, and the increasing reputation as a centre for quality tomatoes attracted more traders again. This recursive development in which farmers and traders hooked onto the success they observed at their colleagues has instigated a process that ultimately led to a situation with predominantly commercialised farming systems. The currently widespread use of purchased inputs and paid labour points at a capitalisation process of the farming systems. Like Lyon (2000) experienced elsewhere, the process seems to have a major poverty alleviating impact, as higher incomes have allowed for stone houses, motor cycles and other indicators of increased wealth. It shows a contrast to the findings of Immink and Alarcon (1993), who explained that crop commercialisation among smallholder farmers has often negatively affected farmers' economic conditions.

Since many development institutions currently promote market-based smallholder development, it is important to point out the structural conditions that have allowed for the development process in Chirodzo and Ruaca. First, the abundance of water and relatively flat land at the time allowed for a quick expansion of the irrigated area[191]. Moreover, since irrigation allows for cash crop production in the hot season, it does not necessarily compete with the labour-intensive production of maize, which is a major constraining factor in

[190] In Chirodzo I regularly joined farmers coming together for a talk, and while some of them promoted intensive tomato production, another one actually favoured organic production; even though he seems to have sufficient capital (he owns 7 cows). In the downstream Nhamanuchi systems I also know two farmers that regularly sit together, but still practice different business strategies, respectively an intensive tomato production and innovative business strategy.

[191] Currently, irrigable land has actually become scarce as farmers have expanded their fields and more people migrated to the area.

various other areas in Mozambique (Green et al. 2006; Lukanu et al. 2007). Furthermore, the use of purchased inputs had been essential for the production of quality tomatoes. Though some farmers have independently increased their farms step by step, the fact that traders offered inputs on credit has fastened the expansion process of many farmers. Next to this, the diverse farming experience that results from the widespread immigration into the area after the war has most probably also contributed to the area's development. To put it shortly, as a whole the area's characteristics comply with nearly all criteria for sustainable market integration of smallholder farmers described by Immink and Alarcon (1993)[192]. Nevertheless, in order to understand the exact role of each of those factors an historic analysis of the recursive market and farming development in Chirodzo and Ruaca should be carried out.

I consider the recursive development of Chirodzo and Ruaca that has been realised without obvious external support as an interesting case to support an alternative model for smallholder development. The case does support the principle neoliberal discourse promoting market-based development, as nearly all farmers have been able to make use of the market opportunities and to increase their wealth as a result of that. However, rather than providing evidence for the outgrower systems that are currently promoted by the Beira Corridor Group, this case supports the idea of Ferris et al. (2006) who emphasise farmers' capacity to innovate and create effective marketing channels themselves. The fact that the few farmers who totally depended on one trader often received lower prices, should be a warning to those supporting the use of outgrower systems.

Nevertheless, while private companies often have the means to create the structural conditions which allowed for the success in Chirodzo and Ruaca, individual farmers often lack those. Therefore, rather than limiting pro-poor development projects to connecting farmers to a certain market, it is important to provide supporting services so that farmers can overcome constraining conditions. The research shows that a true green revolution strategy characterised by large investments in inputs and modern technology had not been necessary to develop the area. Rather, small-scale credit schemes can allow for a basic input use and a step-by-step expansion, and prevents farmers from being dependent on an outgrower or any other major input provider. A second supporting service to promote smallholder development that I want to emphasise are sessions for participative market analysis, as described by Ferris et al. (2006). This is, even in Chirodzo and Ruaca most farmers fail to benefit from the highest tomato prices because they lack a complete understanding of the market system.

Hence, though the booming development of Chirodzo and Ruaca has been allowed for by a range of favourable local conditions, I view the recursive development of farmers' and traders' businesses in the area as a promising basis for an alternative smallholder development model. In my view, this model should link farmers to pluri-actor markets and provide supporting services to create favourable structural conditions. Rather than making farmers dependent on one outgrower, this approach strengthens a farmer's own business capacities and thereby constitutes a more sustainable development model.

Relative water abundance allows for business-driven dynamics in irrigation systems

Finally, I argue that dynamics in farmer managed irrigation systems in relatively water abundant areas differ considerably from those in more water scarce areas. Though in the beginning of the research I explicitly looked for the effects of water shortage on farmers' business strategies, I rather encountered a situation of relative water abundance. Except for farmers with no access to a canal system at all, water users usually found ways to bring about their necessary water use. The different business strategies are spread throughout the hydrological positions within irrigation schemes and the overall research area without any clear link. Moreover, most vegetables are actually produced just before the rainy season, which is the period when stream discharges are the lowest. Hence, water availability does not account for the differentiation of business strategies. The situation of relative water abundance in the research area contrasts to that in the areas studied by Bolding et al. (2009) and Nkoka et al. (2011), who found water mainly as a scarce resource that farmers need to control.

[192] The area only lacks farmer organisations that facilitate joint marketing.

Though I expected farmers' water use to be determined by the socio-political processes through which they claim control over water distribution, it was mainly shaped by the requirements of their business strategies. The fact that like any productive resource, water is used in accordance with the overall business strategy or mode of production, rather corresponds to the findings of Veldwisch and Spoor (2008), who also conducted research in a water abundant context.

The relatively water abundant situation has allowed for the fact that irrigation system dynamics are mainly driven by the business strategies of the involved farmers. Whether a farmer uses his/her position of *dono do canal*, hydraulic position or other claims as described by Bolding et al. (2009) to exert control over water distribution depends on his/her requirements with respect to the quantity and timing of the water flow. The same accounts for making use of his/her social relations to authorities, as described by Nkoka et al. (2011). Farmers that need more water usually strategize in the field of water distribution by using the flow when it's there, and as a result discussions around the allocation of water rights are scarce. Regarding the maintenance of the canal, marginal farmers often default from monetary compensations as they only need little water. Farmers irrigating considerably larger areas than other farmers seem to invest more quickly in the infrastructure, without waiting for the support of other users.

The business strategy of the *dono do canal* is of particular importance for the dynamics in irrigation systems in the research area. Those who cultivate considerable irrigated fields use their authority to stay in control over water distribution, maintenance and the allocation of rights to new users. According to his/her physical position within the scheme and the size of his/her irrigated area the *dono do canal* may actually prevent other users from hydraulic property creation in order to maintain his/her right to control. *Donos do canal* practising a marginal business strategy however, often withdraw from their control and let water distribution and maintenance be determined by the other users. The consequences of this on irrigation system dynamics depend on the particular business strategies and social relations of the other users.

Hence, a recognition of farmer's own logic in both science and development

To me, the main lesson from this research concerns the importance to recognise farmers' own agency, both in terms of scientific analysis and in models for smallholder development. An understanding about farmers' own logic is essential to get insight in the mechanisms that drive individual decisions and processes of differentiation. Rather than forcing farmers into a fixed development pathway, I argue for a flexible approach that creates supporting conditions, so that farmers can adopt business strategies that suit their personalities. To me this is not merely idealism, but also a way for a more realistic and human view on smallholder farmers.

8. Research reflection

Epistemology and the use of concepts

Like I explained in chapter 2.7, whether this research would provide scientifically valuable data to answer the research question depends on ones epistemology (Mason, 1996). As a critical realist I am aware of the fact that my understandings of the physical world surrounding me are socially constructed. My objective to look for different business strategies accounts without any doubt for the fact that I found them. Entering the field without a prepared conceptual framework would have resulted in different research outcomes, but not a single degree less influenced by my personal view. Through acknowledging this imperative bias I tried to minimise its negative effects by using my prior knowledge to make sense of the first data, but having real concepts of importance let evolve during the fieldwork. For instance, at the beginning of the fieldwork I explicitly looked for the role of different assets in explaining farmers' practices as prescribed by the sustainable livelihoods approach. Later however, I found this unsatisfying and started to pay more attention to farmers' actual motivations, which allowed me to identify the role of differing logics instead. It was only back home that I discovered this could actually be conceptualised as the farming styles approach.

Research design

The most obvious weakness of this research probably concerns the small sample size of the researched case study households. Based on the information from 20 case study households I identified 5 different business strategies, which implies that the particularities of individual farmers have played a very decisive role. Nevertheless, a case study is by definition characterised by a small sample size that does not aim at extrapolation or statistical generalisation. Rather, I argue that understanding the particularities of all case study households is essential in order to grasp the complete logic of his/her business strategy. Since a larger sample size would be at the expense of this understanding, the small number of researched households has actually been a deliberate choice. The same issue accounts for the fact that I only researched farmers within 5 multi-user irrigation systems and a few canals with single users. The coincidence that 3 *donos do canal* were marginal farmers has been partly responsible for my conclusion that the business strategy of the *dono do canal* is very decisive in irrigation system dynamics.

A second point for discussion about the research design concerns the use of a typology, that some authors consider as inaccurate to grasp the local complexity (Ellis, 1998). The fact that I did not combine farmers' actual business strategies with an analysis of their life histories implies that some explaining factors may have been overlooked. Nevertheless, this research took the angle from farmers' responses to market opportunities, which proved to have considerably influenced farmers' business strategies as well. The fact that I did discuss key changes in the past production and marketing activities of most case study households implies that I did at least have a glance at their histories and that I would probably have noticed any evidence for a strong role of farmers' past experiences.

Linked to this, I recognise the risk of drawing conclusions on processes I have not observed, but derived from my data indirectly. I have used farmers' information regarding the key changes in their past farming practices to draw conclusions on processes of increasing commercialisation and capitalisation of agriculture. Though I consider those conclusions as sufficiently straight-forward to use, I acknowledge that here too historic research would strengthen the argument. The exact insights I gained about the underlying factors of strategy differentiation have equally arisen in the analysis phase back home. I would be eager to check those findings once more with the particular farmers to verify to what extent those are the result of my own reasoning rather than a reflection of what has driven farmers. However, the strong point in this respect is that those factors have only been identified during the fieldwork and were not prepared at all during the period of proposal writing.

Research methods

The main part of my research has been executed by means of semi-structured interviews with farmers on two moments during the period of fieldwork. The main criticism of interviews is that you only get people's account on a certain subject, which does not necessarily correspond to their actions or perspective. There are three ways by which I have tried to verify those accounts and correct them if necessary. First, my translator David Muchena was a great help in seeing through statements people make when they actually don't know something or have another perspective. Second, I could correct for misunderstandings by combining the interviews with observations. For instance, one farmer had told me about the many crops he cultivates for sales, but when on another day I visited his field I only saw tomatoes and a very small plot of vegetables, we agreed that those crops were actually only for consumption.

The third way to correct for misunderstandings concerns the re-visit of case study households more than a month after the first interview. In this way the previous information could be checked, deepened and added to. At first farmers often mentioned water as their first constraint. I got the impression that this was a socially well acceptable reason for not cultivating a lot. However I assume it also results from the fact that before the period of fieldwork many farmers had seen other students tracking canals, and knew that I was involved in that same project. When continuing the analysis of one's farming system, other factors often appeared more constraining. Hence, while the repeated semi-structured interviews helped me in the end to see through such remarks, structured interviews or questionnaires would not have achieved this understanding.

Another issue to take into account concerns the behaviour of farmers not to talk about others in a bad way. The few times people told me about struggles always followed on long hesitations and the slightly persisting behaviour of my questions. One farmer for instance told me that the information was secret, when he blamed his neighbour for not giving him access to his canal system. As a result, I might have missed information on withdrawing from the maintenance of canals or struggles in the irrigation systems.

Finally, I would like to stress the value of executing the interviews in the field as it allows for longstanding observations. While wandering through a farmer's field I have observed many crops that farmers forgot to mention when I asked for it. Particular features of a production system that are indicative of a farmer's business strategy, such as the use of sticks to carry tomato plants during the rain, can be observed whereas in interviews the topic may not have arisen. Even so, like I described in chapter 6.3, I could directly observe the non-acknowledgement of the *dono do canal*'s power, which provides a much stronger evidence an interview alone. Hence, because of the inductive character of observation I strongly encourage in-site interviewing.

The reflection on the methodology concerning the market analysis is found in chapter 3.1.

References

Albu, M. 2008. 'Making Markets Work for Poor. Comparing M4P and SLA frameworks: Complementarities, divergences and synergies'. FAUNO Consortium, Swiss Agency for Development and Cooperation, Bern, Switzerland.

Alexander, J. 1997. The local state in post-war Mozambique: political practice and ideas about authority. *Africa* **67**,
pp. 1-26.

Ambler, J. 1991. 'Bounding the System: Precursors to Measuring Performance in Networks of Farmer-Managed Irrigation Systems'. Paper presented at a workshop in Mendoza, Argentina.

Bannerman, J. 1998. 'Traditional Peasant Farming Systems in Relation to Conservation, Ecological zones, Land use and Plant Diffusion. Thoughts, Themes and Recommendations'. Paper written for MARRP/DPAP Chimoio, May 1998.

Beekman, P.W. 2011. PROIRRI consultancy, Identification of the Irrigation Potential for Smallholder horticulture in the uplands of Manica and Sofala Provinces.

Birner, R. and D. Resnick. 2005. 'Policy and Politics for Smallholder Agriculture'. In: The Future of Small Farms. Proceedings of a Research Workshop held on June 26-29, 2005, Wye, UK.

Blumer, H. 1954. What is wrong with social theory? *American Sociological Review* **19**, pp. 3-10.

Boelens, R., M. Zwarteveen and D. Roth. 2005. 'Legal Complexity in the Analysis of Water Rights and Water Resources Management'. In: R. Boelens, M. Zwarteveen and D. Roth (Eds.), Liquid Relations. Contested Water Rights and Legal Complexity, Rutgers University Press, New Brunswick, pp.1-20.

Bolding, A. 2004. 'In Hot Water. A Study on Intervention Models and Practices of Water Use in Smallholder Agriculture, Nyanyadzi Catchment, Zimbabwe'. PhD thesis, Wageningen University, The Netherlands.

Bolding, A. 2007. 'The dynamics of smallholder irrigation furrows along the Mozambique-Zimbabwe border: A resilient force of agrarian modernization or last resort for marginal communities?'. Paper presented at a conference in Leiden, The Netherlands.

Bolding, A., N.C. Post Uiterweer, and J. Schippers. 2009. 'The fluid nature of hydraulic property: a case study of Mukudu, Maira and Penha Longa irrigation furrows in the upper Revue river, Manica District, Mozambique'. Book chapter published for Challenge Programme Project 66, Water rights in informal economies in the Limpopo and Volta basins, June 2009.

Bolding, A. 2012. 'The dynamics of smallholder irrigation furrows along the Mozambique-Zimbabwe border: A comparison informed by three case studies'. Paper presented during the 3rd international workshop on comparative water studies, May 2012, Wageningen University, The Netherlands.

Brinkhoff, T. 2010. City Population Mozambique. Available online at: http://www.citypopulation.de/Mocambique.html Retrieved at 10-06-2011.

Bruns, B.R., C. Ringler and R. Meinzen-Dick. 2005. 'Water Rights Reform: Lessons for institutional design'. International Food Policy Research Institute, Washington, USA.

Carney, J.A. 1988. Struggles over crop rights and labour within contract farming households in a Gambian irrigated rice project. *Journal of Peasant Studies* **15** (3), pp. 334-349.

Carney, D. 1998. 'Sustainable Rural Livelihoods: What Contribution Can We Make?' Department for International Development, London, UK.

Chambers, R., A. Pacey and L.A. Thrupp (Eds.) 1989. 'Farmer first: farmer innovation and agricultural research'. Intermediate Technology Publications, London, UK.

Chambers, R. and G. Conway. 1992. 'Sustainable rural livelihoods: Practical concepts for the 21st century'. IDS Discussion Paper 296. International Development Institute, Brighton, UK.

Coward, W.E. 1979. Principles of Social Organization in Indigenous Irrigation Systems. *Human Organization* **38**, pp.28-36.

DFID (Department for International Development). 2001. Sustainable Livelihoods guidance sheets. DFID, London, UK.

Dorward, A. and N. Poole. 2005. Markets, Risks, Assets and Opportunities: the links between the functioning of markets and the livelihoods of the poor. Imperial College London, Wye, UK.

Dorward, A., S. Anderson, Y.N. Bernal, E.S. Vera, J. Rushton, J. Pattison and R. Paz. 2009. Hanging in, stepping up and stepping out: Livelihood aspirations and strategies of the poor. *Development in Practice* **19** (2), pp. 240-247.

Durang, T. and C. Tanner, C. 2004. 'Annex 10 – Planning with regards to land and the management of natural resources'. In: T. Durang (Ed.): Natural resources management support, Manica and Tete province, Mozambique. DPADR Manica, Chimoio, Mozambique.

Ellis, F. 1998. Household strategies and rural livelihood diversification. *Journal of Development Studies* **35** (1), pp. 1- 38.

Farrington, J. 2001. 'Sustainable livelihoods, rights and the new architecture of aid'. Natural Resource Perspectives 69. Overseas Development Institute, London, UK.

Ferris, S., R. Best, M. Lundy, C. Ostertag, M. Gottret and T. Wandschneider, T. 2006. 'Strategy Paper: A Participatory and Area-based Approach to Rural Agroenterprise Development'. Rural Agro-enterprise Development – Good Practice Guide 1. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.

Francis, E. 1998. Gender and rural livelihoods in Kenya. *Journal of Development Studies* **35 (**2), pp. 72-95.

Gold, R.L. 1985. Roles in sociological field observation. *Social Forces* **36**, pp. 217-223.

Green, J. and N. Thorogood. 2009. 'Qualitative Methods for Health Research'. Sage Publications Ltd, London, UK.

Green, M., G. Lukanu, S. Worth, and P.L. Greenfield. 2006. Use of wealth ranking to analyse factors influencing smallholder farmers' market participation in northern Mozambique. *Development Southern Africa* **23**(5), pp. 669-683.

Haarmann, C. 2000. 'Social assistance in South Africa: its potential impact on poverty'. Submitted in partial

fulfilment of the requirements for the degree of Doctor of Philosophy in Development Studies at the Institute for Social Study, University of the Western Cape, South Africa.

Hammersley, M. 1992. 'What's wrong with Ethnography?' Routledge, London, UK.

Hammersley, M. and P. Atkinson. 2007. 'Ethnography, Principles in Practice'. Routledge, London, UK.

Hill, P. 1963 Markets in Africa. *Journal of Modern African Studies* **1** (4), pp. 441-53.

Hoogendam, P., A. van den Dries, J. Portela, M. Stam and J. Carvalho, J. 1996. 'From allocation to distribution: operational rules in a communal irrigation system in Northern Portugal'. In: G. Diemer and F.P. Huibers (Eds.): Crops, people and irrigation: water allocation practices of farmers and engineers. Intermediate Technology Publications, London, UK, pp.111-115.

IFAD. 2001. 'Rural Poverty Report: The Challenge of Ending Rural Poverty'. Oxford University Press: IFAD, Oxford, UK.

Immink, M.D.C. and J.A. Alarcon. 1993. Household income, food availability and commercial crop production by smallholder farmers in the western highlands of Guatemala. *Economic Development and Cultural Change* **41** (2), pp. 319-342.

Johnson, S. 2009. 'Sustainable livelihoods and pro-poor market development'. In: Sustainable livelihoods highlights - October 2009. Institute of Development Studies, Brighton, UK.

Johnston, B.F. and J.W. Mellor. 1961. The role of agriculture in economic development. *American Economic Review,* Sep 1961.

Kalinda, T., G. Filson and J. Shute. 2000. Resources, household decision making and organisation of labour in food production among small-scale farmers in southern Zambia. *Development Southern Africa* **17** (2), pp. 165-174.

Kaplinsky, R and M. Morris. 2001. 'A Handbook for Value Chain Research', prepared for the IDRC.

Kofi, T.A. 1981. Prospects and Problems of the Transition from Agrarianism to Socialism: The Case of Angola, Guinea-Bissau and Mozambique. *World Development* **9** (9), pp. 851-870.

Kotler, P. and K.L. Keller. 2009. 'Marketing Management'. Pearson Education Inc., New Jersey, USA.

Krüger, A.L. 2011. 'Efficiency of the furrow systems in Messica'. Fieldwork report, Irrigation and Water Engineering group, Wageningen University, The Netherlands.

Kruks, S. and B. Wisner. 1984. The State, the Party and the Female Peasantry in Mozambique. *Journal of Southern African Studies* **11** (1), pp. 106-127.

Kydd, J.G. and C. Poulton. 2000. 'Agricultural liberalisation, commercialisation and the market access Problem'. In: Part II of Killick, Kydd and Poulton, The Rural Poor and the Wider Economy: the Problem of Market Access. Background paper for IFAD Rural Poverty 2000 report, Rome, Italy.

Landais, E. 1998. Modelling farm diversity: new approaches to typology building in France. *Agricultural Systems* **58** (4), pp. 505-527.

Laurent, C. , C.J. van Rooyen, P. Madikizela, P. Bonnal and J. Carstens. 1999. Household Typology for relating Social Diversity and Technical Change. *Agrekon* **38** (1), pp. 190-208.

Lemeilleur, S. and J.M. Codron. 2011. Marketing cooperative vs. Commission agent : The Turkish dilemma on the modern fresh fruit and vegetable market. *Food Policy* **36** (2), pp. 272-279.

Lipton, M. 2005. 'Can Small Farms Survive, Prosper, or be the Key Channel to Cut Mass Poverty?' Presentation to FAO Symposium on Agricultural Commercialisation and the Small Farmer, 4-5 May 2005, Rome, Italy.

Lukanu, G., M. Green and S. Worth. 2007. The influence of smallholder labour demand on cultivation of cash crops in northern Mozambique. *Development Southern Africa* **24** (4), pp. 553-573.

Lundy, M., M.V. Gottret, C. Ostertag, R. Best and S. Ferris. 2007. 'Participatory Market Chain Analysis for Smallholder Producers'. Rural Agro-enterprise Development - Good Practice Guide 4. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.

Lyon, F. 2000. Trust, Networks and Norms: The Creation of Social Capital in Agricultural Economies in Ghana. *World Development* **28** (4), pp. 663-681.

Markelova, H., R. Meinzen-Dick, J. Hellin and S. Dohrn, 2009. Collective action for smallholder market access. *Food Policy* **34**, pp. 1-7.

Mason, J. 1996. 'Qualitative Researching'. Sage Publications Ltd, London, UK.

Mawere, M. 2010. Rethinking green revolution program: The impact of Mozambique's fast-track green revolution program on the environment and animal rights. *Journal of Ecology and the Natural Environment* **2**(6), pp. 92-98.

Maxwell, S. 2004. 'Launching the DFID consultation "New Directions for Agriculture in Reducing Poverty" '. Department for International Development, UK.

Meinzen-Dick, R. 2000. 'Property Rights and Maintenance of Irrigation System'. International Food Policy Research Institute, Washington, USA / Eschborn, Germany.

MIPP (Messica Irrigation Pilot Project). 2011. 'Activity Plan'. Consortium consisting of: Irrigation and Water Engineering Group Wageningen University (IWE); ETC Nederland; Resilience B.V.; Haskoning Nederland B.V.; Instituto Superior Politécnico de Manica (ISPM); Caritas-Messica.

Moyo, D. 2010. 'Dead aid. Why aid is not working and how there is another way for Africa'. Penguin Books Ltd., London, UK.

Nkoka, F., A. Bolding and G.J. Veldwisch. 2011. 'Organisational Modalities of Farmer Managed Irrigation Systems in Tsangano District, Mozambique: Lessons for Interveners'. Draft version.

Olwande, J. and M. Mathenge. 2010. 'Market Participation among Poor Rural Households in Kenya'. Tegemeo Institute, Egerton University, Nairobi, Kenya.

Ostertag, C., M. Lundy, M. Gottret, R. Best and S. Ferris. 2007. 'Identifying Market Opportunities for Rural Smallholder Producers'. Rural Agro-enterprise Development – Good Practice Guide 3. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.

Owusu-Gyamfi, M. 2009. 'Growing out of a downturn – Rethinking market development'. In: Sustainable livelihoods highlights - October 2009. Institute of Development Studies, Brighton, UK.

Patton, M.Q. 1990. 'Qualitative evaluation and research methods'. Sage Publications, Newbury Park, USA.

Pilat, D. 1997. 'Regulation and Performance in the Distribution Sector'. Economics department working papers No. 180, OECD, Paris, France.

Pingali, P.L. 2001. Environmental consequences of agricultural commercialisation in Asia. *Environment and Development Economics* **6**, pp. 483-502.

Porter M. E. 1985. 'Competitive Advantage: Creating and Sustaining Superior Performance'. The Free Press, New York, USA.

Poulton, C., A. Dorward and J. Kydd. 2005. 'The Future of Small Farms: New Directions for Services, Institutions and Intermediation'. In: The Future of Small Farms. Proceedings of a Research Workshop held on June 26-29, 2005, Wye, UK.

Reumkens, D. and J. de Boer. 2011. 'A Performance assessment of smallholder irrigation systems in the Manica district of Mozambique'. Two individual internship reports, Irrigation and Water Engineering group, Wageningen University, The Netherlands.

Roncoli, C., K. Ingram and P. Kirshen. 2001. The costs and risks of coping with drought: livelihood impacts and farmers' responses in Burkani Faso. *Climate Research* **19** (2), pp. 119-132.

Rostow, W.W. 1960. 'The Stages of Economic Growth'. Cambridge University Press, Cambridge, UK.

Ruijter de Wildt, M. de, D. Elliot and R. Hitchins. 2006. 'Making Markets Work for the Poor – Comparative Approaches to Private Sector Development'. FAUNO Consortium - Swiss Agency for Development and Cooperation (SDC), Bern, Switzerland.

Sanginga, P.C., R. Best, C. Chitsike, R. Delve, S. Kaaria and R. Kirkby. 2004. Linking smallholder farmers to markets in East Africa. *Mountain Research and Development* **24** (4), pp. 288-291.

Schippers, J.S. 2008. 'Understanding of Water Management Practices in Farmer-Managed Irrigation in Manica District, Mozambique'. MSc thesis Irrigation and Water Engineering Group, Wageningen University, The Netherlands.

Schultz, T. 1964. 'Transforming traditional agriculture'. Yale University Press, New Haven, USA.

Scoones, I. 1998. 'Sustainable rural livelihoods: a framework for analysis'. Working Paper 72. Institute of Development Studies, Brighton, UK.

Silva, J.A. 2007. Trade and Income Inequality in a Less Developed Country: The Case of Mozambique. *Economic Geography* **83** (2), pp. 111-136.

Spielman, D.J., K. Davis, M. Negash and G. Ayele. 2011. Rural innovation systems and networks: findings from a study of Ethiopian smallholders. *Agriculture and Human Values* **28**, pp. 195-212.

Spradley, J.P. 1979. 'The Ethnographic Interview'. Holt, Reinhart and Winston, New York, USA.

Tittonell, P., A. Muriuki, K.D. Shepherd, D. Mugendi, K.C. Kaizzi, J. Okeyo, L. Verchot, R. Coe, and B. Vanlauwe. 2010. The diversity of rural livelihoods and their influence on soil fertility in agricultural systems of East Africa – A typology of smallholder farms. *Agricultural Systems* **103**, pp. 83–97.

Toner, A. 2003. Exploring Sustainable Livelihoods Approaches in Relation to Two Interventions in Tanzania. *Journal of International Development* **15**, pp. 771-187.

Tornimbeni, C. 2005. 'The State, Labour Migration and the Transnational Discourse: A Historical Perspective From Mozambique'. *Wiener Zeitschrift fur Kritische Afrikastudien* **5** (8).

Traerup, S.L.M. 2012. Informal networks and resilience to climate change impacts: A collective approach to index insurance. *Global Environmental Change* **22** (1), pp. 255-267.

Uphoff, N., 1986. 'Improving international irrigation management with farmer participation. Getting the process right'. In: Studies in Water Policy and Management, No. 11, Westview Press, Boulder.

Valdés, A. and W. Foster. 2005. 'Reflections on the Role of Agriculture in Pro-Poor Growth'. In: The Future of Small Farms. Proceedings of a Research Workshop held on June 26-29, 2005, Wye, UK.

Van den Dries, A. 2002. 'The Art of Irrigation. The Development, Stagnation and Redesign of Farmer-Managed Irrigation Systems in Northern Portugal'. PhD thesis, Wageningen University, Wageningen, The Netherlands.

Van der Ploeg, J.D., C. Laurent, F. Blondeau and P. Bonnafous. 2009. Farm diversity, classification schemes and multifunctionality. *Journal of Environmental Management* **90**, pp. 124-131.

Veldwisch, G.J. and M. Spoor. 2008. Contesting Rural Resources: Emerging 'Forms' of Agrarian Production in Uzbekistan. *Journal of Peasant Studies* **35** (3), pp. 424- 451.

Vijfhuizen, C. 2003. 'Woman Farmers Make the Markets: Gender, Value and Performance of a Smallholder Irrigation Scheme'. In. A. Bolding, J. Mutimba and P. van der Zaag (Eds.): Interventions in Smallholder Agriculture, Implications for Extension in Zimbabwe, University of Zimbabwe Publications, Harare, Zimbabwe, pp. 209-227.

WCED (World Commission on Environment and Development). 1987. 'Food 2000: Global Policies for Sustainable Agriculture'. Report of the Advisory Panel on Food Security, Agriculture, Forestry and Environment to the World Commission on Environment and Development, Zed Books Ltd, London, UK and New Jersey, USA.

Whatmore, S. 1994. 'Farm Household Strategies and Styles of Farming: Assessing the Utility of Farm Typologies'. In: J.D. van der Ploeg, and A. Long (Eds.): Born from within: practice and perspectives of endogenous rural development. Van Gorcum, Assen, The Netherlands.

Wiersinga, R.C. and A. de Jager. 2011. 'Linking Kenyan smallholders to the supermarket'. Unpublished edition.

Woodhouse, P. 2003. African Enclosures: A Default Mode of Development. *World Development* **31** (10), pp. 1705-1720.

World Bank and DFID (Department for International Development). 2005. 'Agriculture, Rural Development, and Pro-poor Growth'. Working draft, Agricultural and Rural Development Department.

Yin, R.K. 1994. 'Case study research: design and methods'. Sage Publications Ltd, London, UK.

Appendix A: Tomato production data

All figures in this appendix concern the tomato fields of the different case study households. Farmers without tomatoes or proper data were not taken into account.

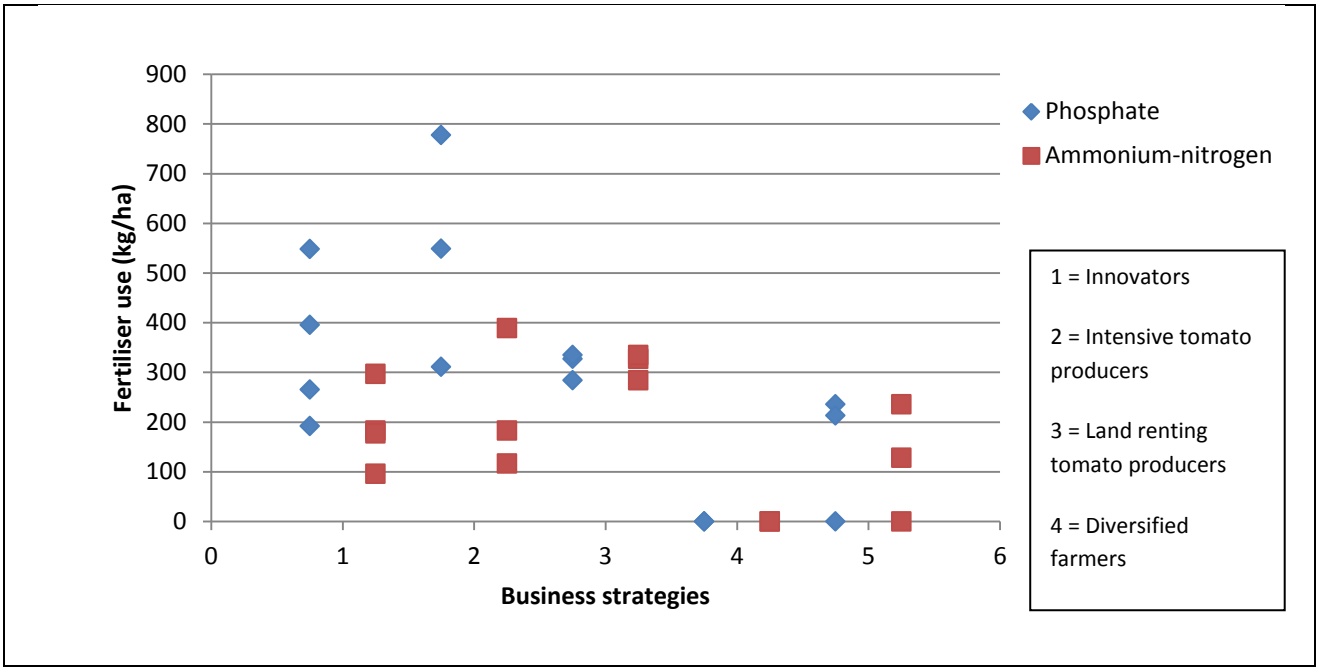

Figure 18 Fertiliser use on tomato field for each business strategy

For the farmers who use fertiliser, the average application of phosphate and ammonium-nitrogen is respectively 370 and 230 kg/ha. Innovators and intensive tomato producers use considerably more phosphate than ammonium-nitrogen, whereas farmers from the other strategy types use equal amounts. This can point at a lack of knowledge about fertiliser application in these groups.

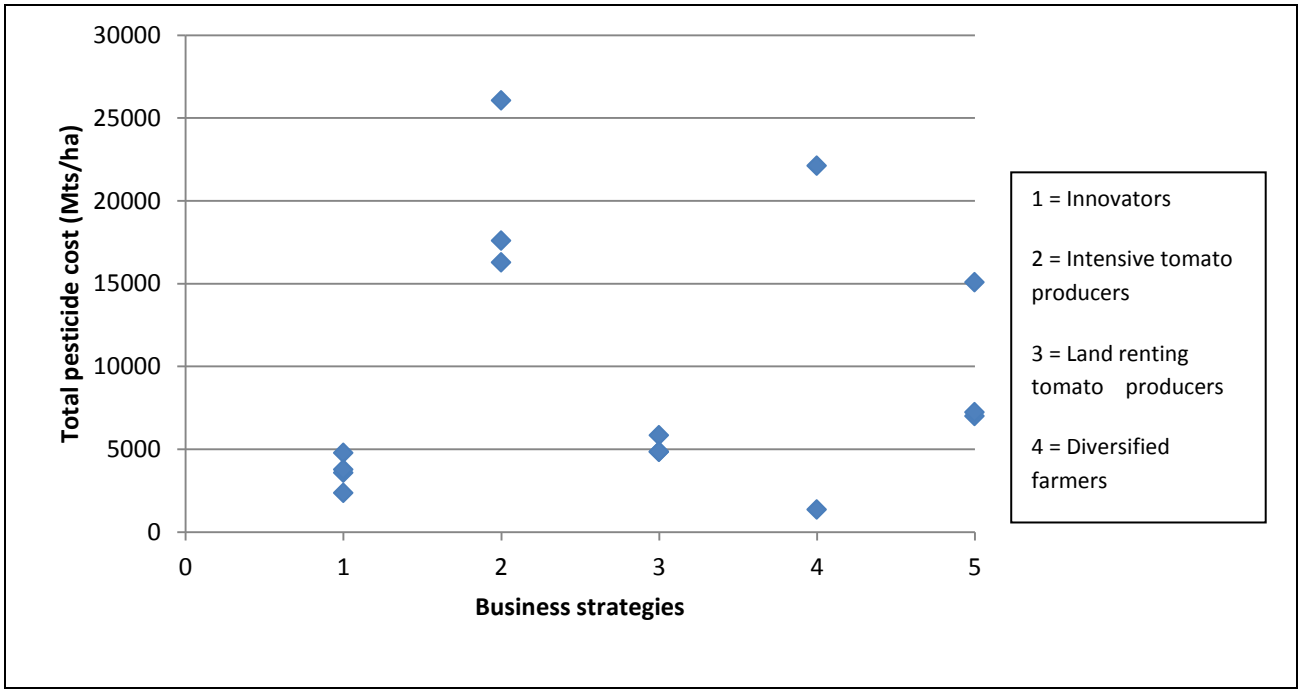

Figure 19 Pesticide use on tomato field for each business strategy

The high values for the diversified and marginal farmers may be a consequence of over-application on extremely small fields.

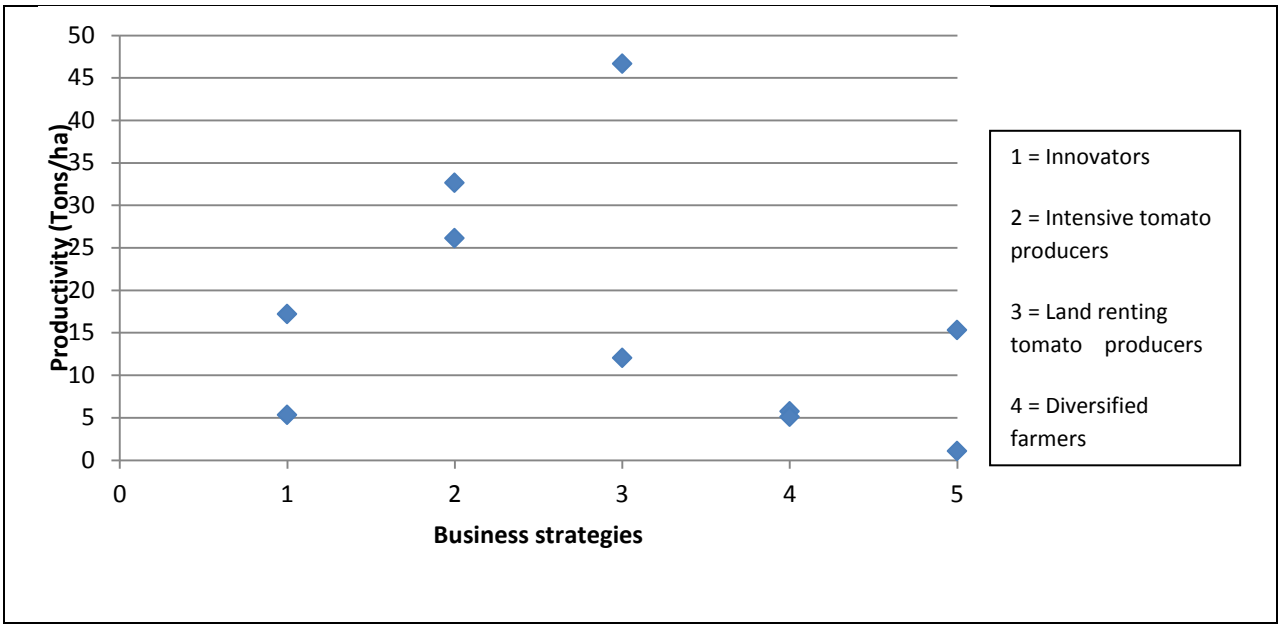

Figure 20 Tomato productivity for each business strategy

The high value for a farmer of type 3 could be misleading, since it refers to a new field which has never been used for irrigated production before.

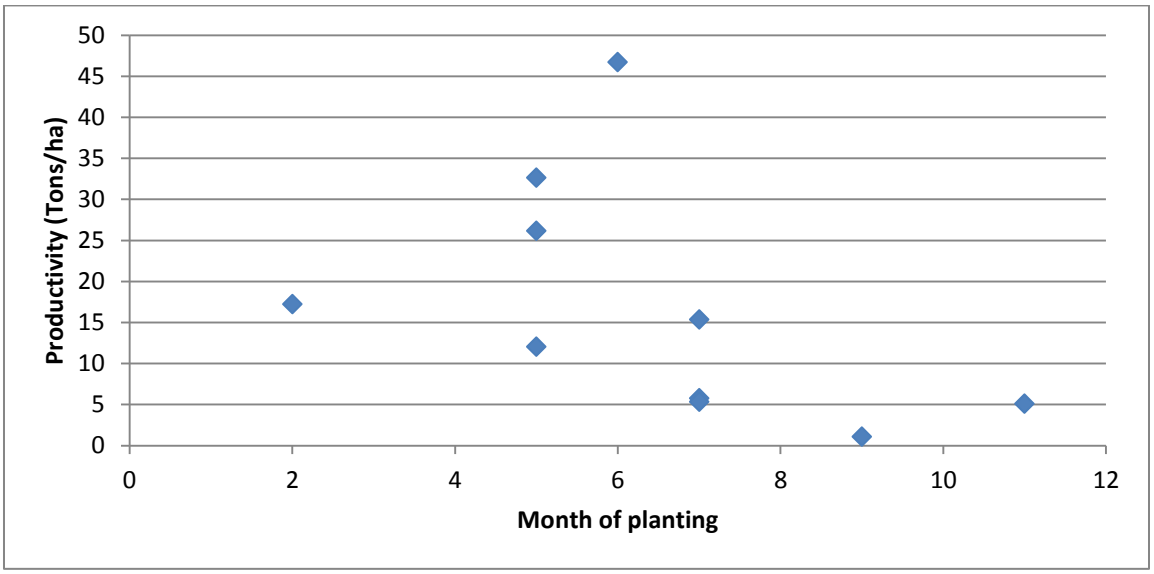

Figure 21 Tomato productivity of different farmers per month of planting

The high value for a farmer who planted in June could be misleading, since it refers to a new field which has never been used for irrigated production before.

Appendix B: Questionnaire for tomato sellers

(Executed with sellers at the *Catanga, Trinta e oito* and *Bazar Central* market in Chimoio and the local market in Messica).

Muito obrigado para participar nesta pesquisa!

	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Otubro	Novembro	Dezembro
O que foi o produto mais importante que você vendeu?												
Onde foram producidos os seus tomates?												
Qual foi o local onde você comprou os seus tomates?												
Comprou os tomates com os agricultores ou comerciantes?												
O que foi o preço médio que pagou por uma caixa?												

Quantas caixas de tomates comprou na semana pasada? ……

Foram caixas de tomates pequenos, normais, grandes ou misturados ? .....

Vende também caixas enteiras? .....

Quanto é que cobra a vender uma caixa enteira neste momento? .....

Appendix C: The selected irrigation systems based on purposeful sampling

In this appendix I show the information on which I based the purposeful sampling of the case study households. The information is retrieved from the initial fieldwork stage and the findings of Reumkens and de Boer (2011).

Nhamazoma2 system 8, 9, 10 (2 households)

These three are the most downstream systems of the Nhamazoma2 river. Actually, it is just called Nhamazoma, but since there are two rivers in the research area with that name I will follow the habit of the other students to call this river Nhamazoma2. All three systems are owned by one farmer called Tobias Sixpense Jairosse. This farmer uses credit from the bank and invested a lot, e.g. in a road to his farm. He is the only user of system 9 and 10, whereas system 8 counts two other users, though with much smaller farms. I want to interview both Mr. Jairosse and one of the other users.

Nhamanuchi system 4 and 5 (2 households)

The farms of these systems are situated next to the farm of Tobias Jairosse. System 4 has five users, whereas system 5 has a single user, called Tendai Steven. I want to include Tendai since he is one of the few single users that has a relatively small farm. During the preliminary research, Tendai told me that he and the users from system 4 benefit from the road and customers of his big neighbour. Moreover, they cooperate by sharing customers and market information, which allows them to serve customers from Chimoio and Beira even though they are relatively small. I did not notice any other cooperation to this extent, and therefore I consider these farmers as a very interesting for my research.

Nhamaguere system 1 and 3 (4 households)

Both systems are situated upstream of the Nhamaguere river, which is according to farmers a river with relatively much water. The systems have two and eight users respectively. I am planning to interview both users from system 1, and two more users from system 3. The owner of system 1 is called Muchairih, and the second user uses sprinkler irrigation. He is a member of the Sabau family, like many others in the two systems. From system 3 I want to interview one of the brothers using this system, and a user that is not part of the Sabau family. I think it is interesting to contrast these two to get an idea about the impact of those family ties on water use and production possibilities. Next to this, I hope to encounter some farmers that made use of credit from *Banco Oportunidade* in these systems.

Chirodzo system 4 (4 households)

This system is located midstream of the Chirodzo river and counts 10 users. It has been studied intensively, both by Reumkens and de Boer (2011) and Krüger (2011). Reumkens and de Boer (2011) showed that there is a high variety of the cultivated area in the hot season among different users. Furthermore, about half of the users have non-cultivated fields, whereas the other half cultivate their complete areal in the hot season. The fact that Krüger (2011) did her flow measurements in this system makes it possible to better analyse the role of water use in this, and in other business characteristics of the different farmers. Moreover, like for the Nhamaguere systems I hope to interview some farmers in this system that worked with *Banco Oportunidade*. For this system I do not have any users that I want to interview in particularly.

Godi system 9 (4 households)

This system is situated relatively downstream at the intensively used Godi river, and as expected farmers reported water shortage during my preliminary fieldwork. In total the system counts 8 users. An important part of that is constituted by 6 farmers who constructed a sub canal without permission from the owner. According to the field notes of Reumkens and de Boer (2011), this resulted in some conflicts. I think it can be interesting to look at the implications of this on farmers' actual water use and further business strategies, including possible collaboration in marketing or securing access to water.

Ruaca system 7 (3 households)

This system is situated downstream at the Ruaca river. Ruaca has less users and more water than Godi, so potentially water problems could be less; although I have not been able to verify the actual size of the irrigated area. The system has 7 users, of which some of them cultivate large areas. One of the users called Chadzuca once used micro credit from a bank. Even though he could not manage the investment (ibid) this does indicate that he is willing to invest, which points at a particular business strategy. Therefore, I am planning to interview this man, plus two other users. Another reason why I included the Ruaca river is that unlike the systems in Chirodzo, there are no associations in Ruaca, which might have consequences on collaboration among farmers.

Non-canal users (2 households)

As explained above, in order to get insight in the reasons and implications of not using canal irrigation, I will also include two non-canal using households. I suppose I will meet them in the field, since during the first weeks practically everyone we met asked me to talk to them. Nevertheless if I do not encounter such farmers I can go back to Fernando Florindo and João Jairoz, with whom I have spoken before. The two of them make use of both naturally wet places and rain fed irrigation of maize. According to David there are not many farmers who have no access to canal irrigation and neither to naturally wet places, and the ones that do so have most of their income from other sources than agriculture. Nevertheless, many of those jobs are probably closely linked to agriculture, like trading, transporting, or wage labour at other farms. It is not the aim of my research to assess the livelihood strategies of those people, but part of this group will be heard during the interviews with key actors in the value chain.