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Adaptation to climate change and other stressors among commercial and small-scale South African farmers

Julie Wilk, Lotta Andersson, Michele Warburton

Abstract Commercial and small-scale farmers in South Africa are exposed to many challenges. Interviews with 44 farmers in the upper Thukela basin, KwaZulu-Natal were conducted to identify common and specific challenges for the two groups and adaptive strategies for dealing with the effects of climate and other stressors. This work was conducted as part of a larger participatory project with local stakeholders to develop a local adaptation plan for coping with climate variability and change. Although many challenges related to exposure to climate variability and change, weak agricultural policies, limited governmental support and theft were common to both farming communities their adaptive capacities were vastly different. Small-scale farmers were more vulnerable due to difficulties to finance the high input costs of improved seed varieties and implements, limited access to knowledge and agricultural techniques for water and soil conservation and limited customs of long-term planning. In addition to temperature and drought related challenges, small-scale farmers were concerned about soil erosion, water logging and livestock diseases, challenges for which the commercial farmers already had efficient adaptation strategies in place. The major obstacle hindering commercial farmers with future planning was the lack of clear directives from the government e.g., with regard to issuing of water licenses and land reform. Enabling agricultural communities to procure sustainable livelihoods requires implementation of strategies that address the common and specific challenges and strengthen the adaptive capacity of both commercial and small-scale farmers. Identified ways forward include knowledge transfer within and across farming communities, clear governmental directives and targeted locally adapted finance programmes.

Introduction

Agricultural production must increase by 70% by 2050 in order to meet the world's demand for food (FAO 2010). Climate change is expected to intensify the challenges already facing agricultural systems and without large changes, productivity is predicted to decline. Increasing productivity would involve lessening the vulnerability of farmers to various types of stressors that can potentially harm their operations. Stressors can include climate-related phenomena such as droughts, flooding and increased risk for fire as well as global changes e.g. trade liberalisation, privatisation, urbanisation and conflicts that affect prices, access and entitlements to food (Ellis 2003). While farmers currently use a multitude of measures to cope with stressors, the impacts of climate change could make these less effective and even introduce new challenges that could further stress already vulnerable communities.

Targeting interventions that influence the context in which various stressors, including climate, occur is often a prerequisite for encouraging and enabling adaptive strategies (O'Brien et al. 2009). The degree to which farmers can adapt depends on their capacity to take actions that lessen negative impacts on their agricultural operations e.g. cultivating a mixture of crops or seeking off-farm income (Reilly and Schimmelpfennig 1999). However even decisions taken outside of communities, on economic and institutional factors, trade agreements and subsidies, greatly influence the outcome of their activities (Eakin and Bojórquez-Tapia 2008).

Enabling adaptive strategies to reduce the impacts of climate change thus requires actions at two levels. Decision-makers need to create and enforce programmes and policies for positive initiatives and farmers need to make informed choices e.g., choosing appropriate crops, crop varieties and planting dates (Pernaud et al. 2005). While access to appropriate information can aid farmers in making sound decisions, response actions and adaptation are not only dependent on good access to information, but also on opportunities to capitalize on the acquired knowledge. When seasonal forecasts were provided to farming communities in Namibia and Tanzania, many farmers were unable to make use of the information because they lacked access to credit, equipment, draft power and markets (O'Brien et al. 2000). The capabilities of farmers to manage climate risks can be enabled or inhibited by a number of factors including existing agricultural policies, agricultural extension support, access to affordable insurance, credit or technological changes and endorsements (Eakin 2005; O'Brien and Vogel 2003).

Africa is often pinpointed as specifically vulnerable to climate variability and change. Large populations live in drought and flood prone areas and the extent of infrastructure, effective institutions and resources are limited (Smith et al. 2003). In South Africa, there is a pronounced difference in lifestyles and pre-conditions between commercial and small-scale farmers. While commercial farmers have tracts of land of hundreds or thousands of hectares on which they raise a diversity of crops and numerous livestock, small-scale farmers practice subsistence agriculture on land plots of often less than a hectare with perhaps a few animals. While these two groups are exposed to the same climate, their different levels of vulnerability and adaptive capacities dictate how

well they can cope and recover from difficulties and capitalize on emerging opportunities. While commercial farmers strive to maximize their yields and earn profits from market sales, the families of small-scale farmers consume the majority of their production, with any surplus sold to friends and neighbours. Increasing the adaptive capacity of agricultural communities to deal with the numerous challenges that they face necessitates integrating climate change related issues with factors related to market risks, current climate variability, and with other policy areas such as sustainable development (Howen 2007). Since 1994, South African government initiatives and policies have aimed to support the smallholders but they have not identified or addressed the root causes of vulnerability. A slow bureaucracy, understaffed government departments with a declining knowledge base and a rapid turnover rate have eroded initiatives aimed at making positive changes.

In South Africa, knowledge transmission between farmers can be an important means of selecting and adopting new and better farming techniques and practices (Chikozho 2005; Andersson 2009). Introductions of new techniques are more readily adopted if adapted to local conditions, tested by leader farmers on experimental plots and if sufficient time is allocated to allow farmers to gain familiarization, trust and new skills (Chikozho 2005; SSI 2009). Farmers can be conservative about implementing new methods if they lack financial reserves (SSI 2009). Previous successes or failures, the relation of gain to risk, income and wealth levels, age and gender of heads of households (Yesuf and Bluffstone 2008) have also been linked to risk aversion.

Means to strengthen adaptive capacity to respond to current and future challenges related to climate variability and change on agriculture, environment and water resources were identified in the project, Participatory Modelling for Assessment of Local Impacts of Climate Variability and Change on Water Resources (PAMO). It was undertaken with government authorities, research institutes, NGOs, commercial and small-scale farmers in the Upper Thukela Basin of KwaZulu-Natal with the aim of developing a local climate adaptation plan.

This paper relates the assessment of the pre-conditions, planning strategies, barriers and opportunities of the commercial and small-scale farmers in two project communities. The main objective is to identify how the farmers interpreted their own reality and their ability to act and adapt. The paper more specifically addresses:

1. Common and specific challenges and responses
2. Planning strategies and their time horizons
3. Priorities in spending and investing related to time horizons
4. Barriers and facilitating factors that influence adaptive capacity and
5. Recommendations for improving local adaptive capacity in relation to those from previous research.

The study area and the two farming communities

The study was conducted in the Winterton/Bergville area in the upper reaches of the Thukela river basin in KwaZulu-Natal, South Africa (Fig. 1). The province was ranked highest of South Africa's nine provinces in terms of exposure and sensitivity to climate variability and change and third lowest for adaptive capacity (Gbetibouo et al. 2010). Assessments of local scale adaptive capacity in KwaZulu-Natal have revealed that in addition to climate, lack of livelihood diversification, access to markets and low capacity and communication with the extension service at the Department of Agriculture (DoA) were key factors contributing to the high vulnerability of small-scale farmers (Reid and Vogel 2006).

The study area contains prime agricultural and grazing lands and receives an average rainfall of 700 mm p.a. (Lynch 2004). Abundant runoff from the Drakensberg Mountains feeds several large reservoirs used for hydropower and other downstream services. While climate scenarios show a drying in the western region of South Africa (Schulze 2011), regionally downscaled climate change projections for the study area, indicated wetter conditions with higher average annual and summer rainfall and fewer days with low river flow. In addition, the frequency of dry and wet extremes could increase (Andersson et al. 2009; Graham et al. 2011).

The small-scale farmers participating in the study came from the Zulu community, Mhlwazini, containing approximately 400 households. It is situated seven kilometres from the Cathedral Peak National Park and has good road access to the nearest commercial centre, Winterton. It has several collectives with four to 130 active members, engaged in, e.g., sewing, brick making, craft making, woodwork and maize production. The farmers grow predominantly maize and some vegetables for their own consumption, with any surplus sold or loaned to neighbours or relatives. The average farm size was one hectare or less (one interviewed farmer had 10 ha). Most practiced dryland agriculture with a minority irrigating from small dams or rivers. Most families obtained their household water from communal outdoor sources. A few households owned small numbers of cattle, sheep or goats. Some obtained extra income from government pensions, government child grants, wage-earning family members, sewing and craft sales. The interviewed farmers had little formal education, from none to primary level.

The commercial farmers belonged to the Bergville or Winterton Farmers' Associations and were of European descent. Most had extensive irrigation systems connected to sizable reservoirs and they grew rainfed maize and

soya bean in the summer and irrigated winter wheat and/or reared livestock for commercial sale. Their cropland ranged from 160 to 2500 ha. Livestock included dairy or beef cattle, pigs and sheep with numbers from 100 to 3000. Many were involved in off-farm activities including businesses, shops, transport companies and restaurants and had educational levels from secondary to college level.

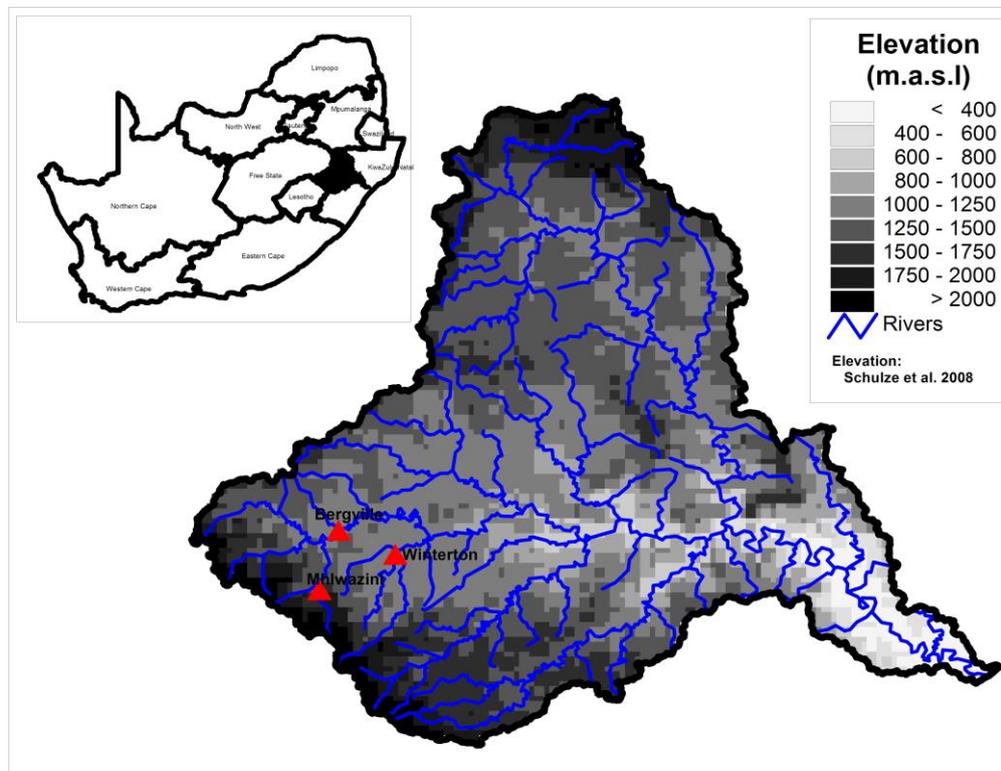


Fig. 1 The study area, situated in the upper Thukela basin, KwaZulu-Natal. The interviewed small-scale farmers resided in the Mhlwazini community; the commercial farmers were members of the Bergville and/or Winterton Farmers' Associations.

Methods

In the PAMO project, modellers compiled regional dynamically downscaled climate change projections and their hydrological consequences according to the identified needs of the participating stakeholders. They then discussed the implications of the effects of the climate change projections and identified relevant adaptation strategies and their limitations and facilitating factors (Andersson et al. 2009; Andersson et al. 2010). The empirical material used in this paper is mainly based on the results of interviews undertaken in the PAMO project supplemented by material from the project's participatory workshops.

Forty-four farmers were interviewed between May 2007 and August 2009. All of the commercial farmers were men except one, which was representative of the male-dominated gender pattern in the study area. The farmers ranged in age from 25 to 65. Equal numbers of farmers were interviewed within the age groups 20-39, 40-59 and over 60. All interviews were conducted in English.

Sixteen of the twenty-two interviewed small-scale farmers were women, which reflected the dominant regional gender pattern (Walker and Schulze, 2006). The farmers ranged in age from 33 to very old (one said she did not know her age but she could be 100). Approximately 50% were in the age group 40-60, and 25% in the 20-39 and over 60 groups. Interviews were conducted with the help of a Zulu interpreter, an agricultural extension officer that the farmers knew and trusted.

The interviews were open and semi-structured allowing opportunities to expand on interesting issues. The commercial farmers associated freely and provided longer answers than the small-scale farmers who answered more concisely. The questions addressed the major challenges facing the communities (general and climate-specific), both shared and specific and how families respond to different shocks in good and bad years. Other questions probed what planning strategies the farmers used to deal with present and future challenges, both general and climate-related, and what factors limited or enabled their capacity to implement effective adaptation

measures. The answers were content coded and categorised to find emerging patterns. Direct quotations from the farmers are shown in italics and with (CF) for commercial farmers and (SSF) for small-scale farmers.

During the interviews, the farmers were asked to participate in a game designed to assess spending and investment priorities related to short-, medium- or long-term planning horizons (Objective 3). Spending related to adaptive capacity e.g. education and agricultural investments reflect a long-term planning perspective while other expenses e.g. within the household reflect short-term necessities. Each interviewed farmer was shown eleven possible items¹ that she/he could buy or invest in, with the option of adding items not listed. The items were categorised into planning horizons representing: the long-, medium- and short-term perspective. Each person was given 80,000 South African Rand (8 x 10 000 notes) representing borrowed money and asked to spend the money as she/he wished. The sum was chosen so that many of the game items could be invested in but not all. They were asked to treat the value of the items equally, so that placing the same amount of money on two items meant that they were equally prioritised. In the second step, the interviewed farmer was given another 80,000 Rand of saved money and asked to spend them. The placing of “borrowed” and “saved” money was to probe any differences between money with risk (borrowed) or not (saved). The items were categorized as: short-term (funerals, weddings, household items, personal items and travelling), medium-term (farm maintenance, house maintenance, cattle, vehicles, medical insurance), and long-term (education, agricultural investments, savings, community projects, starting a business) planning horizons.

Results

On many issues, the commercial farmers associated more freely than the small-scale farmers. Thus, the input from the commercial farmers on some issues is overbalanced.

Challenges and Responses in the Farming Communities

“The challenge of agriculture for a commercial farmer family is about making an income while for a small-scale farmer is about feeding himself” (CF). Both small-scale and commercial farmers face a multitude of challenges, some common and some specific. The challenges identified by the study farmers are presented in Fig. 2, where those in the circles to the left represent the small-scale farmers and those in the right the commercial farmers. Present challenges are shown in black text and challenges that are adequately handled or not applicable are shown in grey. Small-scale farmers still face a number of basic challenges while the commercial farmers with access to insurance, education and finances (shown in yellow in Fig. 2) have already adequately handled them. For example by obtaining crop insurance they are protected from large financial losses or by installing irrigation systems can produce crops year-round and manage drought years. While some challenges at regional, national and global scales were common for both farming communities e.g. climate, bureaucracy and inputs costs, others (in black text) were only significant for the commercial farmers who are linked to the global market (Fig. 2). If and when the small-scale farmers enter commercial agriculture, they too will face these new challenges.

The small-scale farmers were more concerned about climate-related challenges that impacted their crops and livestock from higher and lower temperatures and rainfall amounts. Their use of less climate-tolerant crop varieties, limited use of pesticides, over-stocking of grazing lands and lack of equipment to contour and drain their land and burn firebreaks were factors that hindered their agricultural productivity. The slowness of the government bureaucracy, restrictiveness and delays in the processing of water licenses and the uncertainty of the land reform programme² were factors that commercial farmers identified as most strongly hindering their farming operations. Many commercial farmers had started to make more off-farm investments because of their fear of losing their land. *“We’re starting to put nest eggs in other foreign countries because we don’t know what will happen here”* (CF). They also expressed the difficulty of dealing with global economic and political challenges e.g. fluctuating world markets, volatile input and fuel prices and trade subsidies in other countries that influenced their competitiveness, i.e., challenges which arose from decisions outside of their control. *“You cannot farm for pleasure any more... You have to be on top of technology and changes and so on. It’s a challenge to expand and become more diversified...”* (CF).

¹ The eleven specified items were: agricultural investments, cattle, education, farm machinery, farm maintenance, funerals/weddings, household items, house maintenance, personal items, savings and vehicles.

² There are three main components to the South African Land Reform Programme. The first is land redistribution that aims at transferring 30% of South African land belonging to white owners to previously disadvantaged individuals. The second is land restitution, where restitution of rights in land of people or communities that were forcibly removed prior to 1913 is made, either through re-entitlement of land ownership or compensation. The last is land tenure reform that aims to strengthen the tenure rights of labour tenants.

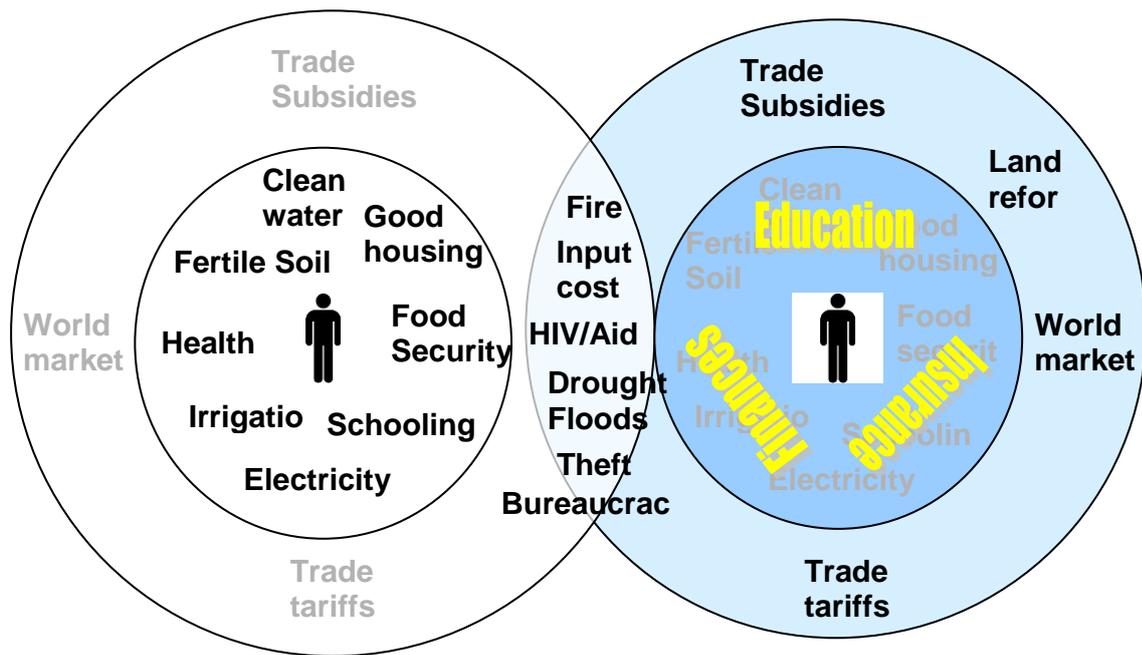


Fig. 2 Challenges to basic needs expressed during interviews, with additional inputs from the participatory workshops. Left: Small scale farmers. Right: Commercial farmers. The inner circle denotes challenges within the local sphere. The outer circle denotes challenges outside the local sphere of impact. The present challenges are indicated in black and non-present (historical or future) are indicated in grey.

Reacting to Good and Bad Years

Commercial farmers expressed that, in bad financial years, except from mental stress that affected their families, they were otherwise not greatly affected (Table 1). They said that even in these years, they would not compromise on anything that would jeopardize their farming systems e.g. reducing fertilizer but instead they would strive to keep their livelihood base strong. In a bad year they might adjust their stock herds to clear some debt and reduce grazing pressure or keep more farm-produced seed for planting. Other responses included cutting back on labour and not paying staff bonuses. Some mentioned that they would increase their bank loans or borrow from business partners in other ventures. One commercial farmer even said that he would “*try to pursue something new, pick up on what's happening, analyse the situation and try and become even more efficient*” (CF). In good years, commercial farmers boosted their adaptive capacity by investing in their farms. They bought or upgraded equipment, filled up their stock numbers, paid off debts, renovated buildings and performed other farm maintenance. On the personal side, they increased their savings, took longer holidays and renovated their homes.

The vulnerability of small-scale farmers to low crop yields was significantly higher. During bad years, their families were drastically affected. They had to reduce even their most basic necessities. They ate only maize and restrained from buying any “luxury” items such as sugar, cooking oil, potatoes and beans. Some mentioned that they bought or begged for food from relatives or neighbours. If they could get work at odd jobs they bought feed for their cattle, otherwise they starved. The one thing that they refused to compromise was their children’s education. In good years, there was sufficient maize for consumption and they also bought vegetables, meat, flour and sugar as well as other households items such as soap. Some of the farmers sold their excess grain to buy fertilizer for the next year's crop. The only long-term agricultural investment mentioned was the purchase of livestock.

	Small-scale farmers	Commercial farmers
Consequences	Reduce food intake Eat only maize	Go out to eat less often No house renovations

	No buying of “luxury foods” e.g. sugar, oil, beans	No new vehicles
	Damaged houses from intensive rainfall	Increased stress
	Increased illness due to damp houses	No holidays
	Difficulty washing clothes in dry years	No new clothes
Responses	Borrow or beg from family/neighbors	Borrow from bank or use savings
	Only grow maize (wheat requires fertilizer)	Expand and diversify
	Use savings to buy maize (for consumption)	Use heat- and drought-resistant seed varieties
	Buy feed for cattle to stop them from starving	Spread fields spatially to lower risk
	Use seeds from previous crop without fertilizer	Use seeds from previous crop
	Take odd jobs (off the farm)	Cut back on labor
	Dig furrows around houses to prevent collapse	Analyze losses and become more efficient

Table 1. Consequences of and responses from the two farming communities to years with low crop yields due to unfavourable climatic conditions.

Planning for the future

The commercial farmers said they could plan for a period of six months up to 10 years. A few said that, due to the political situation, they could not plan at all but just face one year at a time. Their planning strategies entailed minimising debt or staying debt-free, using proper farming practices, trying to ascertain where they are losing money and restrict those activities (Fig. 3). Because of the risk of losing their land from land reform some mentioned moving money out of farming and placing it abroad to insure that they will “*be able to get away*” (CF). Others, despite the risk, carried on as before, expanding and developing, though they were wary and watched developments in neighbouring districts. “*Getting things right with water resources*” (CF) was also a key theme, although it was doubted if access could be improved. “*I think we have done what we can. We’ve built dams*” (CF). Soil conservation, especially the no-till³ method was mentioned as a long-term planning strategy. Some farmers spoke of working hard to ensure a decent living when they get older. Their main worries lay outside their own sphere of influence. “*You can plan your farming techniques, amount of cattle and land, irrigation and what type of cattle you buy. The things you can’t plan for is what the government is going to do, whether it is going to kick us off the land, push in land tax, charge exuberant amounts for water. And you can’t plan the weather*” (CF). Keeping machinery up to date and farming operations strong and having backup like oxen (if tractors break down) or insurance policies were other planning strategies mentioned, as well as budgeting and working toward realistic goals. “*Where do you want to be, where do you want to go to? It is pointless without a goal*” (CF). The time frame of most of the suggested strategies started in the present and moved towards strengthening future financial security (Fig. 3).

The small-scale farmers had much more limited opportunities to plan and prepare for the future. “*They conceptualize the future but are caught in an everyday struggle*” (CF). Most small-scale farmers said they could not plan because they had no money. “*If you want to plant, you have to save*” (SSF). Money represents insurance against costs for expected (fertilizer, schooling) and unexpected (illness, deaths) events. Even when they made plans, many said that too many unforeseen events ate up their savings. “*We do things as they come. When it is time to plough, we collect money and buy inputs*” (SSF). Some however mentioned planning strategies such as diversifying their income e.g. by starting small businesses such as chicken rearing, craftwork and selling cold drinks or fertilising and contouring their land. Many said that the unpredictability of weather hindered them from

³ No-till entails only preparing the seed zone prior to cropping. Infiltration and soil water retention are increased and soil erosion decreased (Yates *et al.* 2006).

effective planning. The only long-term strategies mentioned were education and soil fertility and conservation techniques while other activities only covered the next agricultural season or school year (Fig. 3).

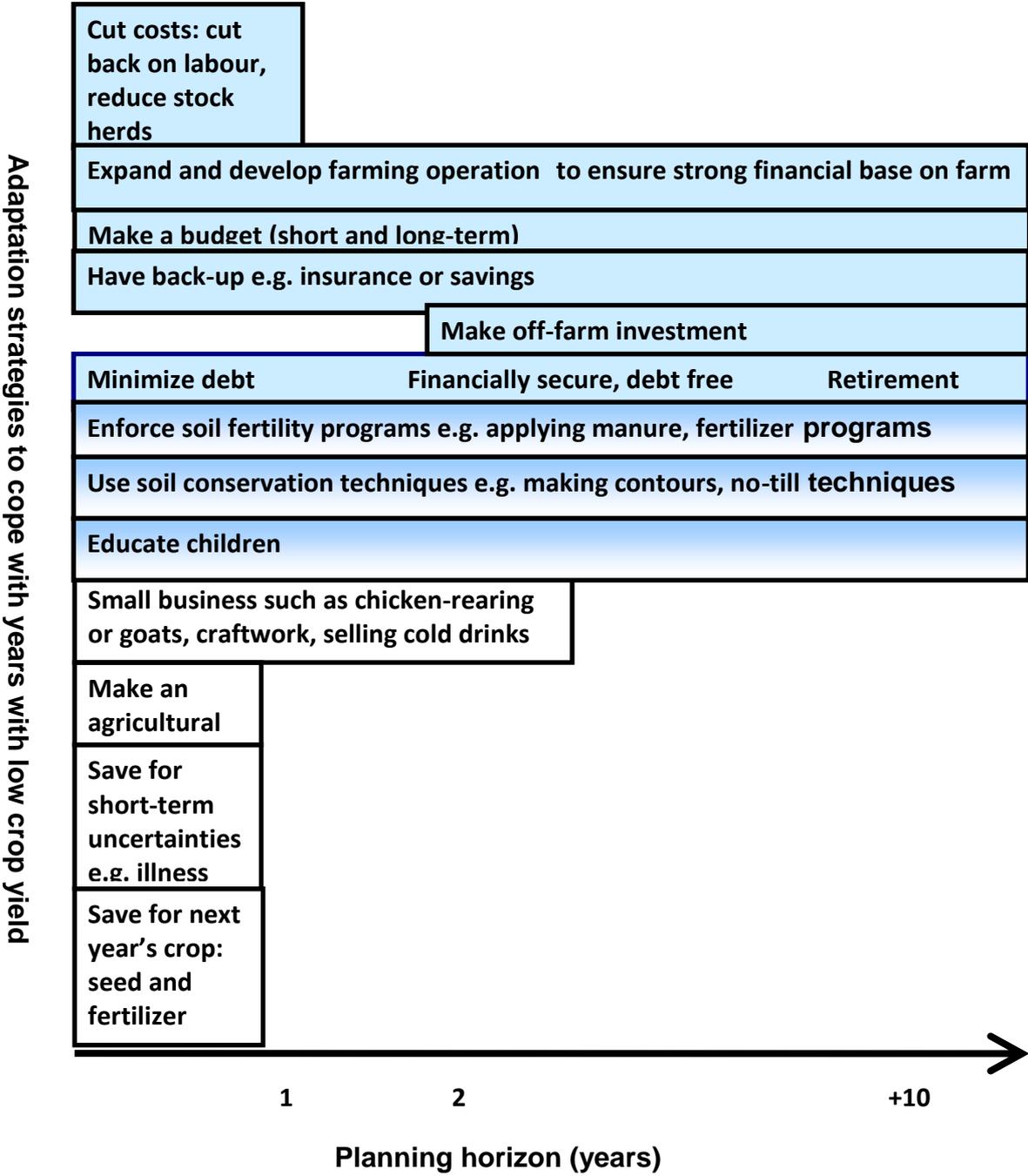


Fig. 3 Planning strategies on a temporal scale. The strategies of interviewed commercial farmers are in blue and of small-scale farmers in white. Common strategies are shown in blue and white.

Planning for climate variability and change

About planning for climate-related challenges, the first thing mentioned by both small-scale and commercial farmers was adaptation to water stress. Some mentioned strategies currently in use, whereas others were things

they would implement if water scarcity intensified (Fig. 4). Many commercial farmers said they had already done all they could do to assure maximum water supply in response to climate change through investments in irrigation systems and reservoirs. Others mentioned buying water from government dams or lessening water demand by growing more drought resistant crops. Some said they would increase their insurance, e.g., against hail. One mentioned the importance of "*thinking green*" (CF) e.g. collecting rainwater for domestic use. Others said if water resources became too stressed, they would move to another area or shift from crop cultivation to livestock, since small dams, sufficient for cattle rearing do not require water licenses. If heavy rainfall increased, they stressed the importance of good contouring.

Small-scale farmers were much more concerned about climate issues including the effects of climate change. Some said that even if they knew that climate change would drastically reduce their water supply they would not be able to act because they do not even have enough water in the current climate. "*There will be no planning because at present we do not have water*" (SSF). Concrete plans included conserving food or water, building tanks or small dams and buying pumps to draw river- or groundwater (Fig. 4). Many said they were not willing to borrow money for water harvesting schemes, because they were afraid of the payments. Others said they would decrease their water demand by reducing their livestock. Small-scale farmers also had concerns about too much water. Excessive rainfall could decrease crop yields, cause house walls to collapse and increase human and cattle disease e.g. caused by sleeping in damp houses or standing in water logged areas. Suggested adaptive strategies included making contours, building stone structures to hinder runoff and digging furrows to lead water away from fields and houses (Andersson et al. 2009).

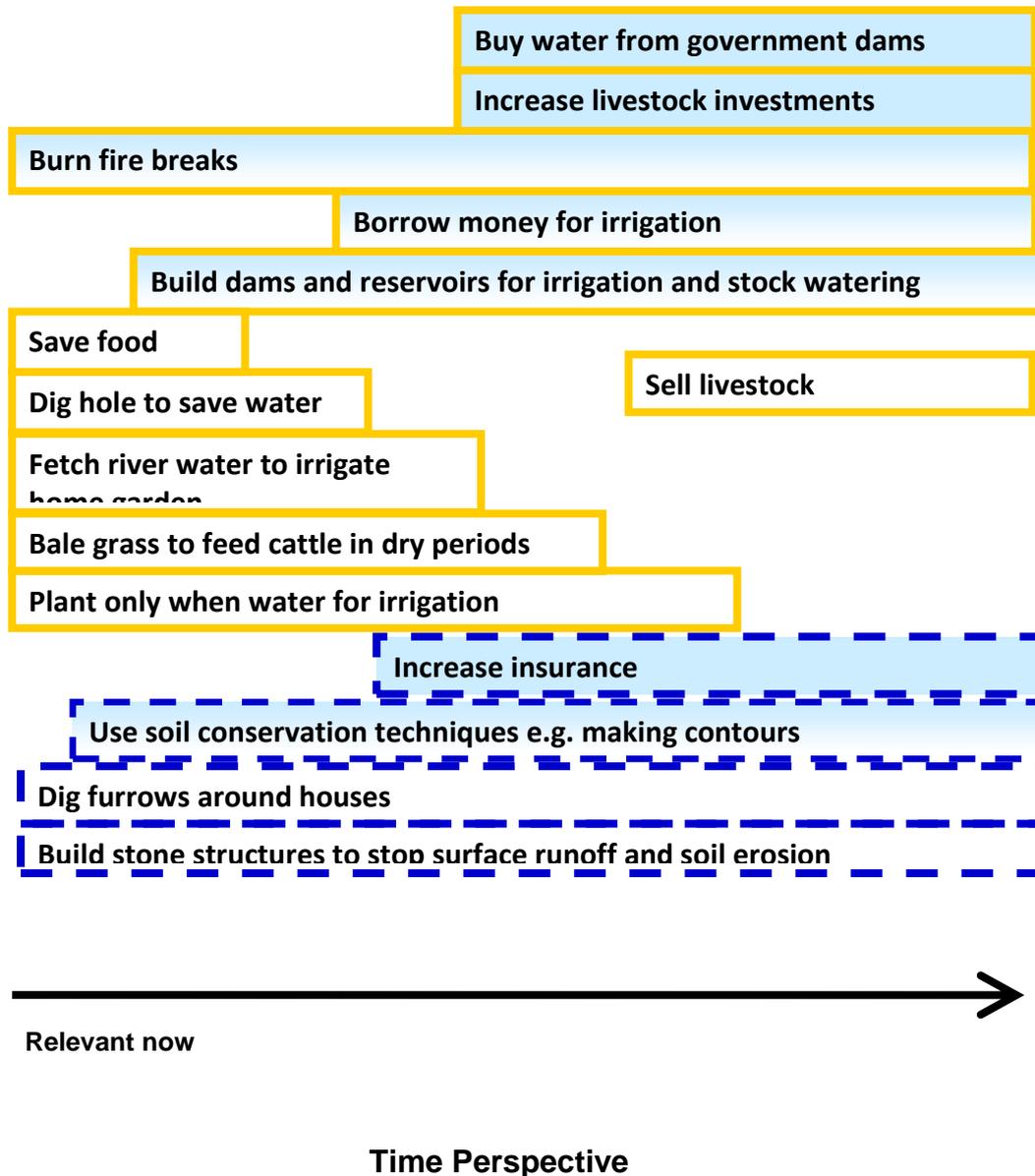


Fig. 4. Planning strategies related to climate variability and change. The strategies of commercial farmers are in *blue* and of small-scale farmers in *white*. The boxes outlined with *blue broken-lines* indicate adaptation to increased risks for heavy rainfall and flooding, and with *yellow solid lines* indicate adaptation to increased risks for drought and fires

Barriers and Facilitating Factors

Differences in adaptive capacity enabling farmers to positively respond to adverse effects of stressful events depend on a number of factors. The factors identified by the farmers as restricting or enabling them to design and implement effective strategies to deal with change are categorized according to: land and water, access to finance, education and knowledge, and mind-set. Factors related to access to technology are included under land and water (irrigation systems) and access to finance (machinery and implements).

Land and water

"With a small farm, a farmer is dead before he even starts. The small-scale farmer doesn't have the economy of scale" (CF). Commercial farmers expressed that they with large tracts of land, sometimes in different areas, were less likely to suffer the effects of local weather phenomena like intense rainfall or hail. In addition, their large farms and greater livestock numbers allowed them to make higher profits in good years. Several small-scale farmers also mentioned the difference in land sizes. "*I don't think commercial farmers have problems. We don't have enough land*" (SSF). Commercial farmers could also use their land value as collateral against loans. They expressed that it is difficult for emerging farmers to compete commercially after land reform because of the small land plots allotted each farmer. "*The farms are too small and the land is not always given to people who have interest in caring for the land and making it profitable.*" (CF). They also added that usually the productivity of the plots was drastically reduced. Maize yields in the nearby Potshini community were raised from 2 to 4.5 tons/ha after the introduction of soil and water conservation techniques (Chikozho, 2005). Commercial farms in the area produce 10-15 tons/ha. While the commercial farmers say their farms contribute to national food security small-scale farms just barely feed the families on them. In poor crop years, grain from commercial farms supports families that need to purchase food. "*Who are going to feed all the chaps that live in Joburg?*" (CF).

Both commercial and small-scale farmers mentioned that most land on commercial farms is irrigated, allowing them to plant earlier and cope better in dry years. "*Commercial farmers are able to provide food even if it's dry because they can irrigate*" (SSF). Irrigation also allowed commercial farmers to crop year-round, thus increasing profits. "*The main difference is that they (CFs) plant throughout the season because they have irrigation systems*" (SSF). Commercial farmers also had ready access to good quality household water, while the small-scale farmers relied on water from open outdoor sources that were sometimes contaminated.

Access to finance

The commercial farmers had good access to finance that allowed them to install irrigation systems, employ labourers and buy costly inputs, e.g., drought resistant seeds, fertilizers, pesticides and machinery. This gave them higher crop yields and livestock gains with which they could strengthen and expand their operations. The improved seed varieties that they purchased annually were considered costly, but worth the investment since they greatly increased their resilience to drought. "*We are having one of our worst droughts ever and we are still sitting on brilliant yields*" (CF). Access to finance also allowed them to diversify into off-farm activities, which boosted their incomes and provided backup in poor agricultural years.

The small-scale farmers expressed that lack of finance made them unable to buy machinery and/or implements for tillage, planting, harvesting and controlling fire through the burning of firebreaks. "*The most challenging is the finance. Families are expensive*" (SSF). They had difficulty investing in good fencing and guards, and suffered often from livestock theft. Government programs were available to assist with certain purchases. For example, it was possible to get a 30% rebate of the payment for certain machinery/implements however, as it could only be claimed after purchase, many farmers could not meet the initial payment. Consequently, due to limited possibilities for machinery investments, small-scale farmers saw themselves as unable to efficiently tend their fields.

Education and knowledge

Both farming groups acknowledged the importance of knowledge passed down from elders, but also stressed that knowledge continually needs updating e.g. on new techniques, equipment, breeding practices, crop varieties and pesticides. Whereas the small-scale farmers were sufficiently concerned about coping with current climate variability, the commercial farmers wanted more locally relevant knowledge on climate change, especially of how it will affect them and what part they could play in mitigation, such as by growing biofuel crops.

The commercial farmers had ready access to expertise. They mainly relied on the advice and support of agricultural agents where they buy seed and fertilizer or meet at farm days. They also hired consultants on occasion to help with unforeseen problems. "*We've got experts at our beck and call*" (CF). An important forum for knowledge sharing was within well-established Farmers' Associations that almost all commercial farmers in the area belonged to.

The small-scale farmers relied exclusively on advice from the extension office of the DoA. The DoA has weakened considerably in the last decades, with insufficient resources to provide adequate support. The farmers mentioned that knowledge was not only needed about agricultural practices but also on budgeting and farm finance, in order to be able to plan and maximize profits, i.e. on how to run a business. In neighbouring Potshini, farmers expressed that capacity building on soil and water management practices needed to be supplemented with knowledge on financial management, book-keeping, making budgets and business proposals (Chikozho, 2005).

Mind-set

The commercial farmers expressed that change was an integral part of their outlook on how to keep their farming operations viable. They were constantly searching to find better alternatives and were flexible in order to accommodate and capitalize on changes. One commercial farmer said that small-scale farmers were bound in traditions and had difficulties in moving with the times. He spoke of their choice of traditional seed varieties, fertilizers and cattle breeds that gave lower yields and less milk. One small-scale farmer mentioned that he bought seed when he could afford it because *"it gives higher yield"*. Choices are not only about tradition but also many times a question of affordability. The commercial farmers remarked that many of the small-scale farmers did or could not think ahead and plan for the future. *"I mean we work for our kids basically. And they (small-scale farmers) all look out for now"* (CF). The small-scale farmers expressed a will for change, to learn more about planning, maximising profits from craft sales but without access to knowledge or finance they could not always actualize these ideas. *"Commercial farmers, because they have more money and bigger farm profits, can do what they plan"*. (SSF). Another pointed to the different manner in which commercial farmers ran their farms. *"Their work is well planned and organised"* (SSF). The small-scale farmers were also described as being more community-minded. Because of their limited profits and opportunities to obtain credit, small-scale farmers have to pool their resources, work together and make collective decisions in order to capitalize on new initiatives. Government programmes also re-enforced collectiveness, as many subsidies were only available to groups of five to 40 farmers. This was sometimes problematic when farmers with different levels of motivation, interest and effort strove to work together with the result of indecisiveness, conservativeness and conflict.

Willingness to take risks was hindered by the fact that many farmers had no financial reserves. Small-scale farmers expressed fear, that if any new undertakings failed, their families would suffer. Unemployment in the community was high and agricultural proceeds had to feed many mouths. Some commercial farmers were concerned that even the mind-set in their own community was too conservative, with too little response to challenges such as new markets, new techniques and global issues such as climate change adaptation and mitigation. *"We can not just rely on what we have and believe that it is everlasting. Whatever it might be - electricity or solar power. I think we've got to look at new options. I do not think we will grow maize here in 50 years. It will have to be a whole new mind-set"* (CF).

Priorities in spending and investing

The interviews revealed that small-scale farmers spent most of their income on basic items like food, shelter, education and clothing but also on some farm investments in seed and fertilizers. If money was remaining, some invested in tractors and other machinery. Others invested in consumables such as cell phones, furniture, vehicles, as well as in funerals and weddings. The commercial farmers invested the main part of their income in the maintenance of their farming operations, including wages, livestock feed, fertilizer, pesticides, seed, electricity and diesel. For their personal needs, priority was on food, education and house renovations.

The results of the game showed small-scale farmers choosing to place approximately 20% of the allotted money on short-term gains, independent of if the money was saved or borrowed (Fig. 5). The main short-term investment with borrowed money was on funerals and weddings, and with saved money on household and personal items (Fig. 6). The commercial farmers were more restrictive with short-term investments, especially when money was borrowed (4%) (Fig. 5).

There was little difference between borrowed and saved money for small-scale farmers for both the medium and long-term time horizon (Fig. 5). There was, however, a tendency to spend more of the saved money on farm maintenance and more of the borrowed funds on house maintenance (Fig 6). They spent a higher proportion of available funds on education than the commercial farmers.

The commercial farmers invested the major part of the saved money on long-term investments, whereas borrowed money was more equally distributed between mid-term and long-term investments (Fig. 5). Like the small-scale farmers, they were more apt to use borrowed money for farm maintenance and cattle and saved money for family purposes e.g. house building/maintenance and new vehicles (Fig. 6). They also put a very high proportion of funds on long-term agricultural investments, especially with saved money (32%).

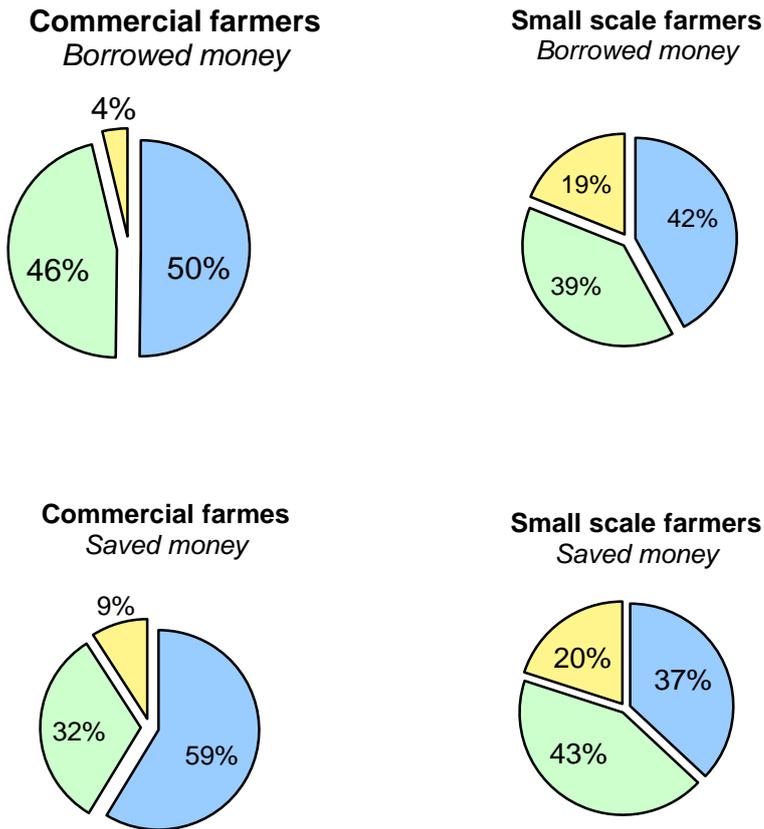
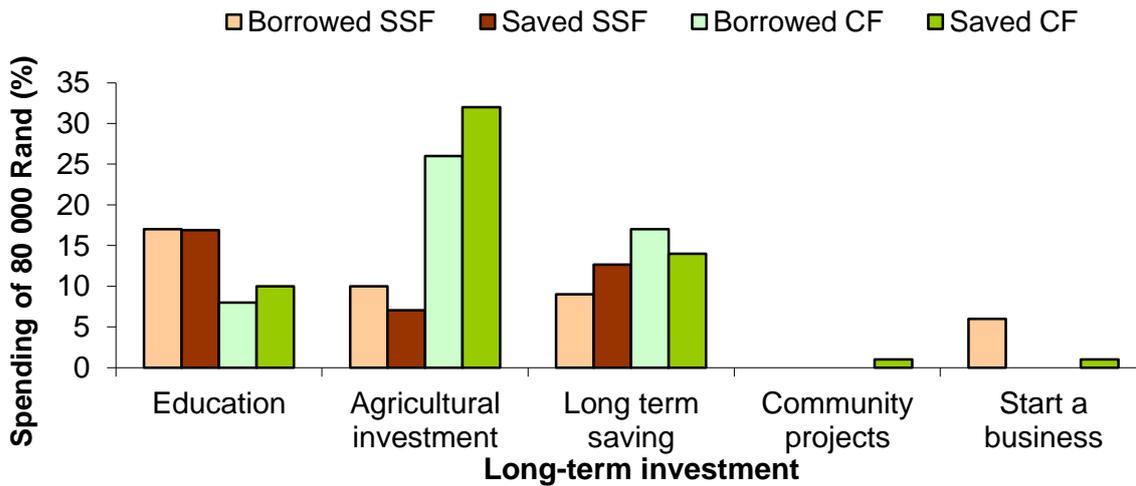


Fig. 5 Results from a game performed during interviews, aiming to assess priorities in spending and investments from commercial and small-scale farmers, with the assumption that they had access to 80 000 Rand from borrowed, respectively from saved funds.



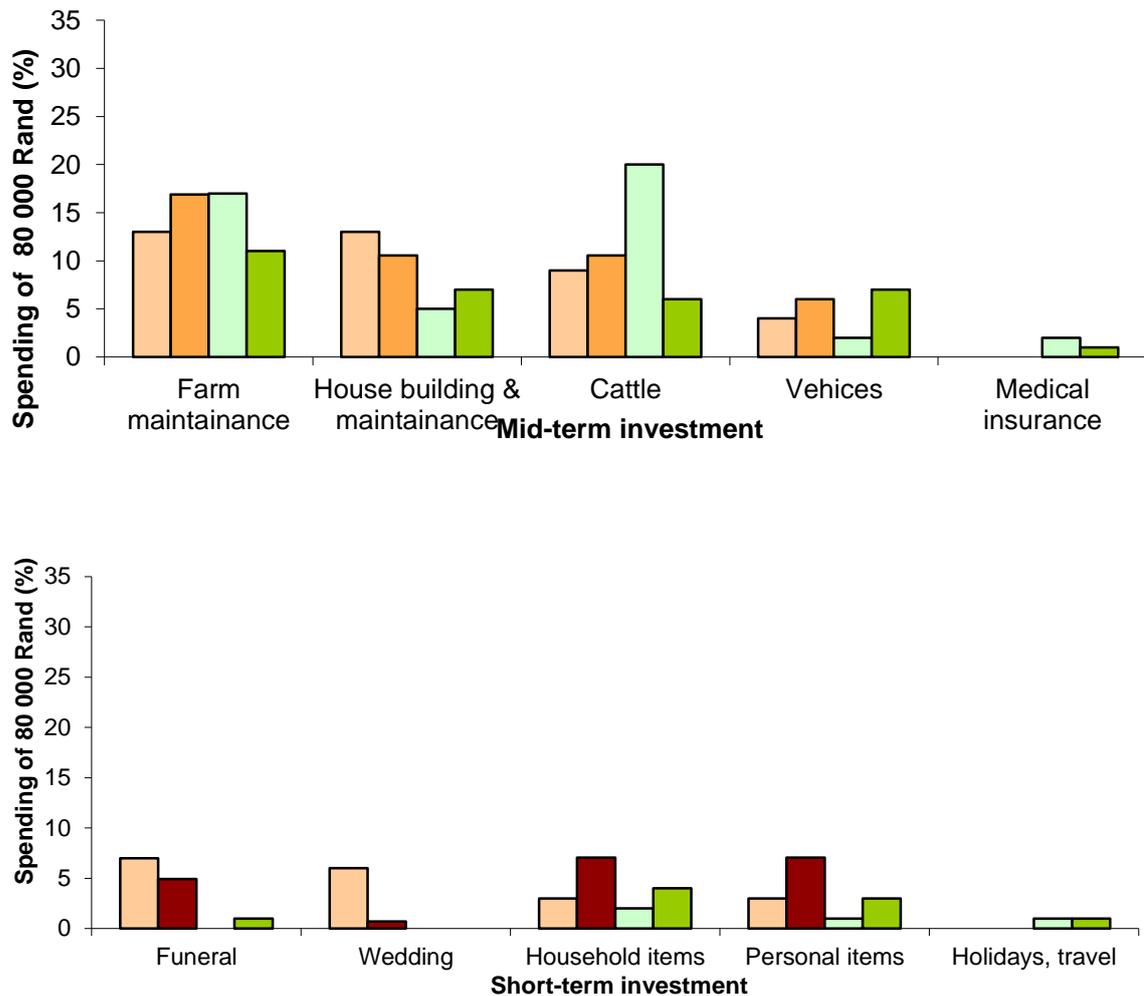


Fig. 6 Items, on which small scale and commercial farmers would spend 80 000 Rand borrowed, respectively saved money. Division is made between a) long-term b) mid-term, and c) short term investments.

Discussion

The way in which the interview respondents interpreted their reality and their ability to act and adapt affects the adaptive strategies that they use. Great disparities could be found in the coping and adaptive strategies used by commercial and small-scale farmers during bad years, in response to similar exposure to climate variability. Some of the small-scale farmers' responses such as eating less and farming without fertilizer decreased their future resilience while those of the commercial farmers' e.g. diversifying into other crops or off-farm businesses even indicated learning from difficult experiences to adapt in ways that increased their long-term adaptive capacity. Some of their short-time coping strategies, however, such as cutting back on temporary labour or reducing staff bonuses, also had severe repercussions on nearby small-scale farming communities.

The short-term planning horizon of the small-scale farmers was a reflection of many factors: finance, mind-sets, habits and experiences. Results showed that much of their spending revolved around securing immediate family needs e.g. food, health care, clothing, funerals and weddings. This could be due to the higher number of interviewed women, as women are most often responsible for care of families. The spending game showed little difference in how small-scale farmers would spend saved or borrowed money. The commercial farmers prioritized cattle and farming investments with borrowed money and only used saved money for personal items. They expressed that borrowed money should only be used to make money while "extras" should only be enjoyed from profits. At the same time, personal items and luxuries to the commercial farmers meant new personal vehicles and holidays while for the small-scale farmers they were basic commodities e.g. sugar, oil and clothing.

The small-scale farmers highlighted their lack of access to finance as one of the main barriers to realizing viable adaptive strategies to climate variability and change. This has been noted in many other studies e.g. Bryan et al. (2009) and Ziervogel et al. (2006). Issues such as improving market knowledge, networks and access (Eriksen and Silva 2009) were not mentioned as important because their current low yields barely support their own needs. While access to markets is important to stimulate market integration, without substantial surplus to sell (the current situation in the study area) this step is premature. It would be more productive to first increase agricultural productivity, as the commercial farmers have already done with improved seed varieties, extensive irrigation systems and higher usage of fertilizers and pesticides. A study in a neighbouring community found that even the improved yields of 4.5 tons/ha, after introduced soil and water conservation methods, still only met household needs and some limited sales within the community (Chikozho 2005). While smallholder maize production in the study area, is often characterised by yields significantly lower than the land potential, the farming households also consider other factors such as social welfare and household food security (Walker and Schulze 2006). Though securing food to provide for their extensive families, made more difficult by unemployment and the effects of HIV/Aids, is a pressing priority of study farmers, they repeatedly highlighted a need to increase their yields to pay health care and school fees, household expenses, agricultural inputs or to save for unexpected events and venture into new enterprises e.g. small businesses. Low productivity levels provide them with little profits and with such small economic margins it difficult for them to take any risks even if the chances for higher yields are promising.

Strategic subsidies and investments that will decrease vulnerability to current climate variability as well as projected climate change are needed to boost long-term agricultural productivity. Agricultural subsidies and grants currently exist to support small-scale farmers e.g. to grow beans, buy machinery and achieve sporadic relief from fire or drought losses. While they do have some positive effects they do not always address the root causes of vulnerability or reflect local realities (nationally promoted crops might not suit all climatic regions). As previous studies have advocated e.g. Reid and Vogel (2006) climate adaptation initiatives should be twinned with other development activities. If farmers invest in strategies that involve economic risks e.g. installing rainwater harvesting structures or changing from subsistence to commercial crops, the measures should fit current conditions as well as take into consideration possible future changes. Similarly, any programmes to boost agricultural productivity cannot be effectively undertaken without addressing key societal issues such as the effects of HIV/Aids and urban migration. Households headed by older women supporting numerous dependents are typical in many African rural areas. These household types tend to be averse to risk (Yesuf and Bluffstone 2008) and potentially high-value technologies like improved seeds and chemical fertilizers. Programmes need to acknowledge and reflect these realities and start by promoting modest, low-risk and environmentally sustainable changes e.g. simple soil and water conservation techniques such as rainwater harvesting and small dam construction.

Opportunities for livelihood diversification such as chicken-rearing and home garden vegetable production would increase the resilience of small-scale farming families and should be supported through more flexible and locally suitable programmes e.g. local DoA offices could adapt national programmes to local needs. A challenge also exists to tailor technological solutions to the smallholders. To promote alternatives to machinery made for large field sizes (used by commercial farmers), exposure (to increase awareness and interest) and subsidies could be targeted towards size appropriate implements e.g. single row planters. Setting up and supporting community trials for different livelihood activities and conservation techniques would encourage more farmers to participate in new endeavours, after witnessing positive results. Government programmes (such as land reform and targeted agricultural subsidies) that currently support collectively managed farms need to include long-term training in agricultural skills and techniques, management and marketing to help them attain or maintain high land productivity. Government subsidies and financing should also be available to individual progressive farmers, not only groups of farmers. Once small-scale farmers have attained yields that allow them opportunity to sell the surplus, access to transport and markets will be vital to enable their integration into commercial agriculture. For the commercial farmers, timely decisions on land reform and water licenses would induce long-term planning and investments. Especially until the agricultural productivity of small-scale farmers is drastically increased, commercial agriculture is important for providing food for a growing urban population and employment opportunities in rural areas.

Meeting the challenge of food security means increased food production per hectare. Updated knowledge on farming practices, soil and water conservation techniques, crop, seed and livestock varieties, fertilizers and possible effects of climate change are essential to supporting productive and progressive farming operations. At the same time, weak agricultural extension in terms of knowledge, number of community visits and response from the DoA to community problems has been highlighted in previous South African vulnerability studies (Reid and Vogel 2006; Ziervogel et al. 2006). While the small-scale farmers in the study were very satisfied with their extension officer, commercial farmers brought up the general problem of the decline of the DoA including the problems of fewer officers (through high staff-turnovers), which had placed a heavy burden on the remaining personnel. Strong efforts are needed within the DoA to entice and keep good quality staff.

In rural KwaZulu-Natal, farmer-to-farmer links were identified as important channels for transferring knowledge and encouraging ventures into new technologies (Chikozho 2005). Farmer field days and visits from neighbouring communities to view field trials also increased farmer interaction and communication (Chikozho 2005, Andersson 2009). Although this link was between small-scale farmers, this study highlighted the potential of another almost non-existent knowledge sharing and collaboration opportunity, between small-scale and commercial farmers. The small-scale farmers brought up a number of subjects that they would like commercial farmers to teach them e.g. weed control, planning and organization of farming activities. Many of the interviewed commercial farmers expressed a willingness to mentor small-scale farmers about agricultural and conservation techniques, budgeting and planning, but added that there were no obvious forums for this. This could be initiated by including commercial farmers in farmer exchanges and cross-visits that already are current meeting points for small-scale farmers. Another constructive starting point for knowledge exchange and cooperation could be on addressing two challenging areas that both communities were concerned about: control of wild fires (which could increase in the future with increased dry periods) and livestock theft. An obvious bridge between the two communities is the DoA which should not only have the role of transferring external knowledge to farmers but also learning from them and integrating and spreading this knowledge to other farmers (Chikozho 2005). As almost all commercial farmers belong to Farmers' Associations and many small-scale farmers belong to Farmer Forums, links could be established that span these organizations.

Conclusions

Although exposure to climate variability and change was similar for the two farming communities, their sensitivity and adaptive capacity to deal with stressors were vastly different. Effective agricultural planning is based on taking advantage of good production years (e.g. through investments and savings) in order to minimize the consequences of years with less favourable conditions. The high sensitivity of small-scale farmers to external stressors and their limited adaptive capacity to deal with negative impacts was strongly linked to their inability to access finance, knowledge and technologies that would make their farming operations more viable. Yields and incomes need to be increased. Measures such as harvesting rainwater, practicing no-till and contouring would increase their agricultural productivity, conserve soil and water resources and even be solid steps towards preparing for a future KwaZulu-Natal with increased frequencies of wet and dry periods. The challenge however is to mobilize resources, training and good practices that lead to their implementation. As this region of South Africa is projected to be wetter in the future while other regions would be drier, increasing productivity would be very strategic. The future climate could even allow double cropping per growing season and farmers to access the growing market for new consumer demands such as organic and high-end produce. Damper conditions however could also have negative impacts e.g. increased human, crop and livestock disease. Although any initiatives should take into account the risks and opportunities linked to climate change, already supporting small-scale farmers to deal with the climate variability they face today would go a long way in equipping them to better meet future challenges.

Improving access to training and knowledgeable advisors and increasing communication within and across the farming communities through knowledge sharing forums are concrete means to support and encourage small-scale farmers to improve their farming operations. Since small-scale farmers often have to pool their resources to capitalise on new investments (and in order to qualify for subsidies) and because many have small economic margins there is a risk of indecisiveness in groups and risk aversion. Subsidy programmes should be adjusted to local conditions and to meet the needs of small-scale farmers. These could include subsidies targeted towards groups or individuals that are willing to do pilot assessments of new methods or crop varieties, which also cover mandatory insurance costs against unforeseen economic losses. For commercial farmers, transparency and timely and definite decisions on land reform and water licenses are needed to promote stability and long-term agricultural planning. As land reform entails converting large tracts of land under single ownership to smaller plots owned by a number of farmers, extensive long-term training and support is imperative to deter a decline in agricultural productivity that would have serious implications for regional and national food security. While advantages of small-scale systems exist e.g. higher motivation of family members than hired workers, deterrence of urban migration and proximity of land thus increasing chance for experimentation of methods (IFPRI 2005), without long-term government commitment to build the agricultural and managerial capacity of the emerging farmers, these are often heavily outweighed by a serious decline in agricultural productivity.

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