Oxfam Research Report

OVERCOMING THE BARRIERS

How to ensure future food production under climate change in Southern Africa

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Contents

Jean Phombeya, head of Mlanga village, Malawi, tends her vegetable garden.

On the cover: Killa Kawelama and his wife Janet in their fields in Malawi. Photograph: Nicole Johnston

GROW

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ABSTRACT

Farmers in Southern Africa are already experiencing changes to their climate that are different in magnitude to what they have experienced in the past. Some of these changes, particularly higher temperatures and greater rainfall intensity, are consistent with what scientists expect to happen as the Earth's climate warms due to emissions of carbon dioxide and other greenhouse gases. These changes are adding to other political, economic and environmental stresses on their livelihoods.

This report comprises new field research by Oxfam and Kulima Integrated Development Solutions with over 200 farmers in five countries of Southern Africa. It finds considerable agreement between farmers across countries that they are observing changes in climate. The perceptions of farmers largely find backing in the meteorological data. Ongoing climate change, bringing increasing temperatures and further changes to precipitation patterns, is projected to make food production more difficult. Recent scientific research compiling the results of many thousands of field tests on maize, in particular, demonstrate the serious effects of temperature increases and changes in moisture (Lobell et al, 2011a). Climate change is likely to reduce yields and increase food prices, with serious effects on both farmers and consumers. Farmers are already actively experimenting and changing agricultural practices and pursuing ways to diversify livelihoods in light of both the new changes to their climate and other multiple stresses. In some cases, these changes can be considered actual or potential successes in adapting to climate change; in other cases they may be simply coping, and other strategies can be considered maladaptation, particularly where they create environmental degradation. Furthermore, whereas large-scale farmers, in the main, have access to the resources needed to adapt, small-scale farmers face major obstacles. These obstacles may not only prevent adaptation but also lead farmers into maladaptation, for want of other choices. Major new resources must be raised from domestic, regional and international levels to focus on and build the adaptive capacity of small-scale farmers and sustain levels of food production into the future.

◂ **Tea-picking in Gurue, Mozambique. Photograph: Nicole Johnston/Oxfam**

EXECUTIVE SUMMARY

Farmers in Southern Africa are already experiencing changes to their climate that are different in magnitude to what they have experienced in the past. Some of these changes, particularly higher temperatures and greater rainfall intensity, are consistent with what scientists expect to happen as the Earth's climate warms due to emissions of carbon dioxide and other greenhouse gases.

For this report, Oxfam and Kulima interviewed different types and scales of farmers about their experiences in select locations in Zambia, Zimbabwe, Mozambique, Malawi and South Africa. They consistently report hotter conditions year round and changes in the rainy seasons, notably later onset and earlier cessation as well as rain falling in more intense bursts. These changes effectively shorten growing seasons and result in greater unpredictability of rainfall within the rainy season.

Farmers say these changes are increasing the risk of poor yields or crop failure, and they must invest more time, energy and resources. Declining tea production in Malawi, for example, cuts earnings and reduces demand for labour, increasing hardship and poverty for farmers, labourers and their families.

The observations by farmers are borne out by temperature records, although meteorological data for rainfall corresponds less. It is known from extensive field trials across the region that rising temperatures and increasing aridity reduce crop yields, particularly of maize. For the future, temperatures will continue to increase, although how far depends on how much greenhouse gas emissions can be curtailed.

Farmers, both large- and small-scale, have had to cope with a high degree of natural climatic variability and extremes and have been, and continue to be, as resourceful, enterprising and experimental as possible within their resource constraints. Recent temperature increases and changing rainfall patterns have given extra impetus to modifications in agricultural practices.

These include changing planting dates, planting in new locations, intercropping, dry planting and diversifying crops. Two particularly important strategies are acquiring modern hybrid and early maturing seeds, and using conservation farming to maintain soil moisture. Diversifying livelihoods continues to be an important lifeline for many poor families. However, some strategies – such as farming along riverbanks and "vleis" (seasonal lakes) – will bring problems in the long term and can be considered "maladaptation" to climatic stress.

Furthermore, many barriers exist to farmers as they attempt to adapt to the new climate and other environmental, economic or political pressures. For policy makers, it is important to identify these barriers in order to begin to dismantle them. Among these barriers, we find:

- Large-scale farmers have more access to the resources needed to adapt than small-scale farmers, but the greatest gains in productivity could come from the small-scale sector, which employs large numbers of people across Southern Africa.

- Low incomes and high costs of inputs necessitate greater access to credit, stronger government social protection systems and subsidy programmes for seeds and fertilizers.

- Lack of technical knowledge argues for government re-investment in agricultural extension

▲ **Transporting cooking oil in Mozambique. Photograph: Neo Ntsoma**

services and better communication of information, advice and forecasts.

- The voices and participation of farmers themselves need to be strengthened through collective organisation and action.

- Small-scale irrigation and better water management have great potential, provided key conditions are met.

With the right support, it should be possible to limit future increases in the price of food to manageable levels despite climate change; but if the right policies are not pursued, prices could increase substantially – by more than 100% for maize and rice by 2030, for example (Willenbockel, 2011). Southern African governments need to invest in agriculture and meet their NEPAD commitments to increase the share of agriculture in national budgets to at least 10%.

The forthcoming UN climate conference (COP 17) in South Africa in November/December this year is crucial both for cutting greenhouse gas emissions and for producing the additional finance needed by developing countries to adapt to climate change.

1.

CLIMATE CHANGE IN SOUTHERN AFRICA

Observations by farmers and meteorological data

Edson James Kamba, a subsistence farmer in Balaka district, Malawi. Photograph: Nicole Johnston

▲ Women pick spinach from a food garden in the Matobo district of Matabeleland. Photograph: Nicole Johnston

Over 200 farmers were interviewed for this report and all said that over the past 10 years they have noticed changes in the climate as compared with the 1990s. The most widespread change, observed by all farmers in all countries, is changing distribution and intensity of rainfall. In particular, summer rains are perceived to start later and end sooner, and to be more variable within the season.

Tea farmers in Malawi, for example, observe that the rainfall tends to stop between November and January, instead of lasting until March; and that the "Chiperoni" showers, from April to July, are now increasingly rare. This confirms similar observations from previous Oxfam research in Malawi, where farmers observed increasing unpredictability and changes to wind patterns (Magrath and Sukali, 2009).

Large-scale commercial wheat farmers in South Africa also cited as problems the changes in seasonality and rainfall intensity. While there was general agreement that annual rainfall totals, and even the eight-to-10-year drought cycle in South Africa, seem to be unchanged, farmers agreed that the rainy season is starting later and is increasingly characterised by high-intensity rainfall events. Most respondents noted an emerging pattern of more winter and less summer rainfall, although not all respondents hold this view. Respondents in the coastal region of Strandveld in the Western Cape, where summer rainfall associated with "black South-Easter" wind conditions is an important contributor to total annual rainfall, noted an increase in rainfall intensity and associated flooding. Several wheat farmers, particularly in Strandveld, noted an increase in wind speeds, particularly of the rain-bearing westerly winds.

In Zimbabwe, by contrast, the 10-year drought cycle seems to be accelerating. Farmers remember very regular and predictable rainfall in the 1970s, starting in mid-October and ending in April, with ephemeral rivers beginning to flow around Christmas. A drying trend was first noticed in the 1980s, with droughts occurring in 1982 and 1987. The 1990s brought further droughts — in 1992, 1995 and 1997 — and these continued into the 2000s, becoming so severe that they necessitated the adoption of short-term coping strategies to maintain food security, such as the collecting of wild fruits to augment food supplies.

In addition to changes in the timing, duration and intensity of the rain, other farmers commented on the unpredictability of rainfall. An established commercial cotton farmer in Mozambique said:

> "In the past (around five years ago) [it] was much easier to plan the crop season. Rain would start always in mid-November and end in March/April, however, nowadays this is no longer predictable."

Unpredictability was also noticed in the increasing frequency of dry spells within the traditional rainy season. In Zambia, small-scale farmers spoke of the increasing regularity of droughts in February, which are then often followed by floods. Officials in the Zambian Meteorological Department told Oxfam researchers that they believe that the growing season in the south of the country has reduced in length over the last decade.

In South Africa, large-scale commercial wheat farmers spoke of differences in temperature variation throughout the year. One farmer observed that summer temperatures were now 2°C to 3°C higher on average, while winter temperatures were cooler.

In Zimbabwe, small-scale farmers noted that the seasons are no longer well defined, but run into each other. Winters are mild, with increased heat during the day, but very cold temperatures at night.

One Zimbabwean woman respondent, whose vegetables were destroyed by frost on the 25th of June, said:

> "This year there was severe frost bite in June, which affected a lot of trees in the forests and all garden crops including sugarcane, which we [have] never known to be affected by frost."

1.1 Correlation with other observations

Over the last decade, Oxfam field staff and researchers have interviewed farmers in many countries and published their findings in a series of reports (see *http://policy-practice.oxfam.org.uk/publications*). It is striking that farmers across the world show a remarkable unanimity in observations of seasonal change, particularly regarding later onset and earlier cessation of rainy seasons; less gentle and well-distributed rainfall within the seasons, with rain falling in more intense bursts; and generally higher temperatures and longer hot, dry spells within rainy seasons, with effects on soil moisture (see, for example, Jennings and Magrath, 2009).

A young girl sells mangoes in Kasungu district, Malawi. Photograph: Nicole Johnston

1.2 What meteorological records say about current trends in climate

The increased unpredictability of the rainy season, lower rainfall and higher temperatures observed by farmers are borne out in meteorological records, which show clearly that there is warming over much of the subcontinent.

Over much of Southern Africa, from 1960 to 2006, temperatures have increased by between 0.6°C and 1.3°C (or an average of approximately 0.2°C per decade). This is generally similar to other regions of the globe, although rates of warming are slightly higher over the interior of the subcontinent, relative to coastal areas (IPCC, 2007). Patterns of change in temperature extremes over Southern Africa largely follow those for average temperature. The occurrence and duration of cold days and nights has decreased, while the occurrence and duration of extreme hot days and nights has increased (New et al., 2006). This is supported by the observed temperature trends at the national level for Malawi, Mozambique and Zambia (for more detail, see the appendix, from McSweeney et al, 2010).

In contrast to observed temperature changes, observed rainfall changes over the subcontinent seem to show no clear pattern. It is difficult to see any particular trend, largely because of the natural significant inter-annual (or seasonal) rainfall variability of the region and its complex topography. There is regularly considerable inter-annual variability, which can bring about drought or floods, seriously affecting farmers.

1.3 Exploring the differences between farmers' perceptions and meteorological data

Meteorological data supports farmer's perceptions well when it comes to temperature. The data shows average total annual rainfall remains very much the same – although this is likely due to the fact that the entire Southern African region has always been characterised by variability, so "average" means little in reality. In contrast to this less dramatic picture, farmers are almost unanimous in experiencing significant differences in the rainfall regime. In Oxfam's experience, however, this may well be because two subtly different things are being measured.

"Farmers measure the 'amount' of rain not in isolation but according to what it is supposed to do, i.e. in relation to the water requirements of certain crops. Small amounts of rain in the dry season may be described as large, because the rain is assessed in relation to what it will grow, such as dry season wheat rather than rice. Even if the total amount of rain has not changed, a perception that a particular season is becoming 'drier' might be a summation of hotter temperatures (reduced soil moisture through increased evaporation), changed patterns of rain (greater run-off caused by a higher proportion of rain falling in intense events) and changes in water storage capacity of land and soils." (Magrath and Jennings, in Devereux et al, Seasonality, Rural Livelihoods and Development, forthcoming 2011)]

Meandering through the flooded waterways of Zambia. Photograph: Oupa Nkosi

Over much of Southern Africa, from 1960 to 2006, temperatures have increased by between 0.6°C and 1.3°C.

Summary of the research methods

This study looks at current and projected changes in climate and their impacts on production in the context of recent past and present variability, and responses to climatic changes, in order to draw out ways in which adaptation to climate change can be supported. It does this using a multi-method approach, combining desktop review of climate projections and likely impacts on crop production with qualitative data from primary research with farmers on how they have responded to past climate variability and new changes, and where they perceive the barriers to climate change adaptation to be. Field research used a mixture of focus groups and one-to-one interviews.

Since the focus of this report is primarily food production, as opposed to food security, emphasis was placed on looking at both small-scale and large-scale farmers. Both are important to food production in different ways: small-scale farmers produce the majority of food, which is consumed by the rural poor, while large-scale producers are critical in a country's aggregate production.

In order to gain insights from across the region, different types of farmers were researched in different countries. Results of the primary research, therefore, refer largely to small-scale farmers in Malawi, Mozambique, Zambia and Zimbabwe, and large-scale farmers in South Africa. However, it is important to note that South Africa has a large number of small-scale farmers as well, in the same way that the other countries have large-scale commercial farmers that contribute substantially to their production levels (particularly for export).

▲ Green Leaves Cooperative members tend to their kitchen garden. Photograph: Matthew Willman

Bearing the brunt of a changing climate

In the face of a changing climate and its subsequent impacts on food production, small-scale women farmers in the Western Cape are finding themselves eating less or nothing at all, saving the little food they do have for their families. Despite their willingness to adapt, these producers lack support to access markets, land and resources owing to myths that small-scale farming is for subsistence only.

Auntie Jacoba Arramut Armoed (56), who lives with her family in Rawsonville, Breede River Valley, says the biggest struggle is not having enough food. She participates in a project run by Oxfam partner organisation Women on Farms Project (WFP), in which women's cooperatives build the capacity of seasonal and unemployed workers to increase their income. Their cooperative grows gourmet mushrooms, which they sell to a commercial farmer in Stellenbosch. The women receive a stipend of R500.

Auntie Jacoba says her community is witnessing the impact of climate change on the crops they plant and the quality of their produce. "Definitely, there has been a change that has happened because it must be winter now, but instead we get weather that is one week warm. On our land we have planted beetroot, spinach and cabbage, and those plants are just too small and this is because of the weather, which is very cold."

She says their crops failed this year because "the land had not been cultivated yet. So fertiliser had not been thrown on the ground. It is the first time we plant on it, that together with the weather that is so cold." The women are currently using simple techniques to adapt, planting crops that survive in colder weather and using mushroom locks for compost.

Women are more vulnerable to the impacts of climate change because of their role in providing food for their families. They are finding it hard to cope with rising food prices and the increasing demand for food as their families expand. Access to land remains a struggle. While the cooperative has managed to secure land from the municipality, the women plant their crops in fear that they may be removed from this rented land since ownership is reviewed every three years.

2.

CLIMATE CHANGE IN SOUTHERN AFRICA

Impacts on farming

2.1 Farmers' observations of current effects on crops

Temperature increases and reductions in soil moisture directly stress crops. More importantly, crops are particularly susceptible at certain key times during growth, such as "tasseling" in maize. Furthermore, for farmers the more unpredictable the climate, the greater the investment of time, energy and resources required to seize the right moments for crucial farming activities, notably planting or transplanting, and to maintain crops (and animals) through dry spells. More erratic weather tends to lead to more erratic outcomes in terms of harvests.

Farmers noted how rainfall is not only more erratic over the season, but also geographically. In Zimbabwe, they noted how crop production levels tend to vary widely even within wards, and how drought hotspots exist next to areas with good harvests. Aridity also affects animals, directly through heat stress or indirectly through loss of pasture and water sources.

Some traditional varieties of crops have disappeared or are now little-cultivated, with several farmers in Zambia saying that these traditional varieties were unable to survive the new climates, with their shorter rainy seasons and poor rainfall distribution. This lack of fallback makes it crucial that farmers are able to access new varieties, or they will have nothing.

The changing climatic conditions are affecting crop productivity, and farmers generally perceive the weather conditions during the season to be the biggest determinant of crop production levels. However, the extent to which these changes play a role differs and is intimately linked to other factors, including the availability of inputs such as seed, fertilizer and animals for ploughing.

In Malawi, drier conditions directly affect yields of tea. One smallholder tea producer noted that in the past he would harvest tea every week, but now green leaves are only ready for harvesting once or twice a month. Another smallholder tea producer indicated that with the decrease in the Chiperoni rains (April-July), she is barely harvesting a bag full of green leaf from her field in June, whereas in the past, when the showers did occur, she would harvest more than 10 bags in the same period. A tea estate manager in Malawi said:

> ***"These rains [in May] used to boost tea production during the relatively dry season, but now these rains are virtually not falling anymore. This means our factories are running empty for longer periods of the year, which is a big inefficiency. This also means we have to lay off staff earlier every year, and this affects their livelihoods as they have families to look after. You find a rain falling in traditionally dry months and you find prolonged dry spells in the traditionally rain season months. This is increasingly becoming a headache to the estates, especially when it comes to how we plan and manage our labour requirements."***

2.2 Studies show impacts of temperature increases and rainfall changes on crops

In general, across the region it is hard to currently predict exactly how a warming atmosphere will change particular climates in particular places, beyond the certainties that there will be increasing temperatures and changes in rainfall patterns and in the capacity of soils and vegetation to hold moisture. However, it is possible to foresee the impacts of these trends on some crops.

A recent study by David Lobell and other scientists ("Nonlinear heat effects on African maize as evidenced by historical yield trials") analysed the results of more than 20,000 actual experiments on maize, the most important food crop in the region (Lobell et al, 2011a). These field trials – testing maize under temperature and water stress –

had been carried out between 1999 and 2007 in 123 research stations managed by the International Maize and Wheat Improvement Centre, National Agricultural Research Programmes and private seed companies across Southern Africa. This data set was combined with daily weather data. Lobell and colleagues show that each temperature "degree day" spent above 30°C reduced the final yield by 1% under optimal rain-fed conditions and by 1.7% under drought conditions (Lobell et al, 2011a).

These may seem like small reductions on the face of it, but the study shows that at maize-growing sites that were above 25°C in average temperature, exposure to temperatures above 30°C was frequent and there was a 10% yield loss per degree Celsius of warming. Maize yields "are significantly hurt in areas where temperatures commonly exceed 30°C … Under drought conditions, even the coolest trials are harmed by 1°C warming, with losses exceeding 40% at the hottest sites".

Globally, another study indicates that maize production fell by 3.8% between 1980 and 2008, and wheat by 5.5%, relative to a counterfactual without climate change (Lobell et al, 2011b).

Gender impacts of changing climate and its effects on crop production in Malawi

Women labourers on tea estates in Malawi were particularly concerned with the changing weather patterns and how this is affecting their power and influence within their households and society at large. A women-only focus group discussion (FGD) highlighted the fact that when a woman is earning less than she used to from tea picking, she loses some of the respect and influence she commanded in her home and the community. Her influence on decision-making (both in the home and the community) is diminished. "When we are making less money from the tea estates, due to the fact that the tea is not growing fast enough in these drier conditions, the men feel like we are being a burden to them in the homes, and even the community at large. They no longer want to give you the respect which they do when they know that you are making enough money."

Interestingly, it also emerged in the men's FGD that the reduction in labour opportunities in the estates is eroding the respect, power and influence they usually command when regularly employed and earning more money. "If you do not make more money women say you are not man enough and they have no reason to accord you any respect as a man. Even in the household, the wife does not treat you with any respect. But, when you are regularly employed and are making regular money, you are treated with respect everywhere you go. This climate change thing is killing our dignity as men."

The women's group highlighted how the diminishing labour opportunities in the tea estates are affecting access to basic services such as clinics for their children under five. "When you are regularly employed [as an estate casual labourer] and are able to make some money from the tea estate labour, you can easily skip one day of work in a week and go for the under-five clinics. But these days, with the slow growth of the tealeaves, it is not easy to meet the day's target and therefore you just have to be at work every day if you are to make ends meet. It is also difficult to ask someone to take your child to the clinic if you do not have money. But when you are making more money, you can easily ask someone to take your child to the clinic and they will easily accept since they know that you will give them something when they come back from the clinic. Life is generally getting harder with these changing weather/ climatic conditions."

3.

CLIMATE TRENDS FOR SOUTHERN AFRICA

What the future might hold

Janet Zamadunga winnows maize in Mlanga village, Malawi.
Photograph: Nicole Johnston

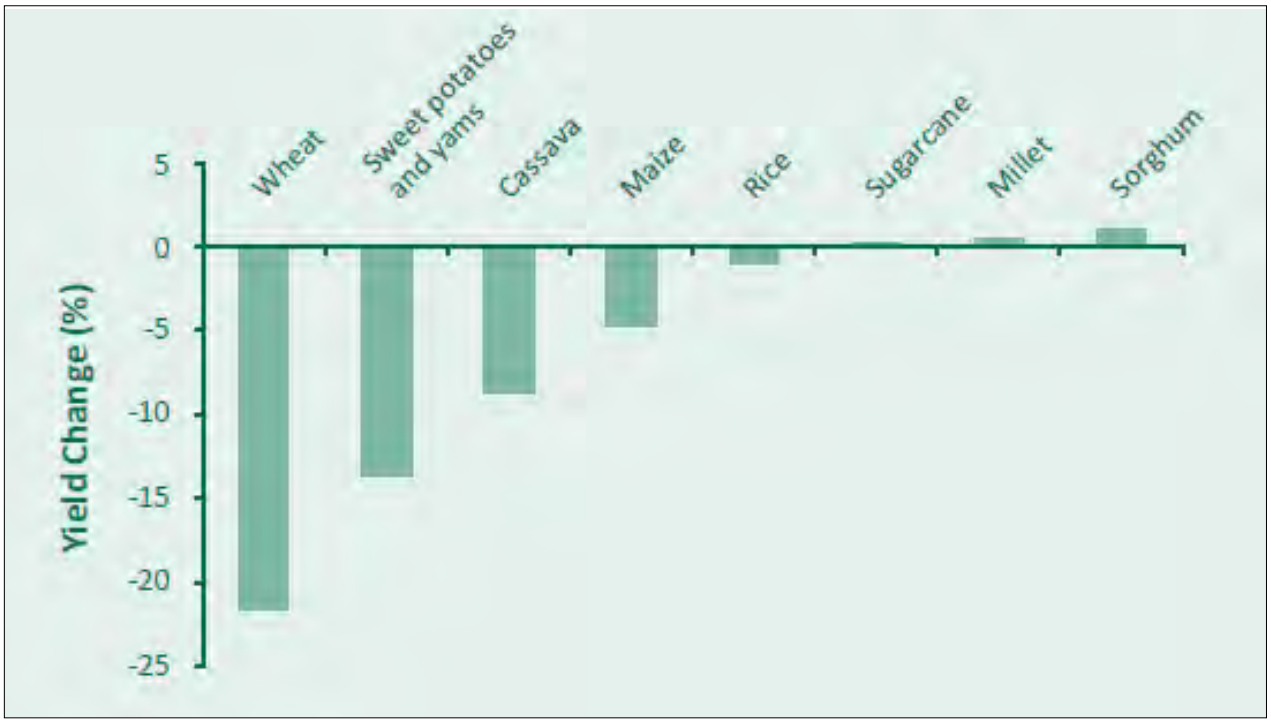
3.1 Future temperature and rainfall changes

The IPCC Fourth Assessment Report projects future global average temperature change to be in the range of 1.1°C to 6.3°C by the end of the century, depending on how we change the level of emissions in the atmosphere (a rise of 1.1°C will result if we introduce stringent policies to curb emissions, while 6.3°C is a "worst-case" scenario, where emissions continue to increase at a rapid rate). Similar projections exist for Southern Africa, with the greatest warming occurring over interior regions. One forthcoming study using statistical and dynamically downscaled climate model projections for Southern Africa projects maximum temperatures to increase up to 3.6°C by the end of the century (Davis, C (ed), *Climate Risk and Vulnerability: A Handbook for Southern Africa*, CSIR, Pretoria).

Past observed trends in extreme temperatures in the region are also projected to continue, with cold days and nights occurring less often and extreme hot days and nights occurring more often, becoming hotter and longer in duration. Summary statistics for projected temperature changes for each country can be found in the appendices (based on McSweeney et al., 2010).

Rainfall is more difficult to project accurately. Global Climate Models (GCMs) are very large-scale and become progressively less reliable as they are used to predict more local climate. In particular, these models generally do not have the spatial resolutions to simulate rainfall processes (such as convection) accurately, which are very important over Southern Africa. Also, rain-gauge data from Africa is relatively poor, so baseline data is sometimes lacking, reducing the quantity of input data to the models. That said, some consensus exists for a small increase in summer rainfall over the southeastern parts of the subcontinent and slightly drier conditions in the central and northern regions of Zimbabwe and Zambia by the latter half of the 21st century (see, for example, Davis, 2011; Department of Environmental Affairs, 2010; Engelbrecht et al., 2009; Tadross et al., 2005). The distribution of rainfall within the seasons will also continue to change.

Photograph: Neo Ntsoma



Projected changes in Sub-Saharan African crop yields due to climate change, 2050 (Source: Ringler et al, 2010 - compiled by the authors based on IFPRI IMPACT modelling projections).

3.2 Implications of future changes for crops

The study on historical yield trials for maize by Lobell et al (2011b) concludes: "Under optimal management, negative yield impacts were projected for roughly 65% of the area where maize is harvested at present in Africa." If management is not optimal and all maize areas undergo drought, then 100% of maize areas are projected to exhibit yield declines, with more than 75% of areas predicted to decline by at least 20% for 1°C warming.

Other studies reviewed for this report show broadly similar results, with a general consensus that climate change effects on crop production will be negative, although there is less consensus on the extent by which yields will decrease. A recent review of the impacts on crop productivity under climate change for Africa and South Asia suggested significant yield decreases for wheat (-17%), maize (-5%), sorghum (-15%) and millet (-10%) (Knox et al 2011). Ringler (et al 2010), using a different set of crop yield models, comes up with slightly different results but the same trend.

▲ A produce market in Kaomba, Zambia. Photograph: Oupa Nkosi

3.3 Impacts of climate change on future food prices

Like other regions in the world, Southern Africa has been affected by two food price crises in the past five years. The number of people who achieve food security through purchase, rather than growing their own produce, is also increasing in the region. As a result, there have been widespread protests across Africa (particularly in Mozambique in the Southern African region) against the high cost of living, in which increased food prices played a large part. Potential changes in food prices as a result of climate change are therefore also important to consider.

A recent analysis uses the GLOBE model (which takes account of situations within countries, as well as the role of the global economy) to assess food price increases up to 2020 and 2030 under a range of scenarios, including climate change (Willenbockel, 2011). In this analysis, the Southern African region includes the five Southern African countries in this report plus Botswana, Namibia, Swaziland and Lesotho.

If climate change is taken into account, along with projected growth in the population and labour force, technical progress (i.e. factor productivity growth), capital accumulation and land use, the projected price rises are startling.

With climate change in the model, maize costs nearly 105% more in 2030 than in it did in 2010 and paddy rice costs over 107% more in 2030 than in 2010. In Willenbockel's analysis, maize prices would rise by "only" 34% without climate change. In other words, climate change more than triples the cost of maize after the changes due to the other factors are taken into account. It also more than doubles the cost of rice and wheat.

As we shall see, however, Willenbockel's model assumes that prices can be kept considerably lower, even with climate change, if the right actions are taken to help smallholder farmers raise yields.

4.

FARMERS RESPONSES TO PAST AND CURRENT CHANGING CLIMATE CONDITIONS

Given the widespread recognition of changing climate, on top of regular extremes and other stresses, in Malawi, Mozambique, South Africa, Zambia and Zimbabwe, it is not surprising that farmers have been, and are being, extremely resourceful and enterprising insofar as they can be within their resource constraints. They have been carrying out a wide range of response strategies to maintain their livelihoods. While these strategies may vary from one context to another, they can be broadly grouped into four categories: modifying farming practices; modifying crop types and varieties; resource management; and diversification of activities.

In order to obtain regional coverage and to take into account their varying roles in production, both small-scale subsistence farmers and large-scale commercial farmers are examined within this report.

Small-scale farmers were interviewed in Malawi, Mozambique, Zambia and Zimbabwe. Previous research shows that small-scale farmers in South Africa have responded in similar ways to climate variability and change (Gbetibouo et al, 2010; Sterrett, 2007; Thomas et al, 2007; Goulden et al, 2009). Likewise, large-scale commercial farmers were interviewed in South Africa, but their range of responses and barriers to those responses are likely to be similarly experienced by large-scale farmers in other Southern African countries.

▲ **Fanizo Chamba sifts maize flour in Mlanga village, Malawi. Photograph: Nicole Johnston**

4.1 Modifying farming practices

Modifying farming practices and cultivation techniques is one response to try to maintain production levels under changing climate conditions. Particular practices observed include changing planting dates, planting in new locations, intercropping and dry planting.

Changing planting dates

One of the most widespread strategies for dealing with the increasing variability of the onset of the rains is to change planting dates. In Zimbabwe, villages typically had a universally accepted planting date. Over time, however, this became untenable and now people plant as soon as the rains arrive. In some cases, they stagger their crop, so that if the first one fails (for example, if the first rain does not signify the onset of the rainy season), they have a second and third crop that may survive. In Zambia, maize farmers would wait for the rains to come twice for the soil to be moist before planting. Now they plant with the first rains to increase the chance of the maize producing cobs before the rain stops.

Planting in a new location

With declining production levels, farmers increasingly have to seek new land to cultivate. In many cases, however, this is difficult. In Zimbabwe, farmers in both Gutu and Chirumhanzu districts reported that while they used to farm in demarcated, arable areas, they have been extending their fields to ecologically sensitive areas including waterways, water channels and wetland areas in search of better soil moisture in case of drought (see box).

The need for new land is compounded by many factors, including population increases, land grabs and the fencing off of formerly communal land for commercial crops, cattle, wildlife or industry.

South African large-scale commercial wheat farmers similarly plant on new land, but for different reasons. One farmer explained this as "get bigger or get out" and "adapt or die". Among commercial wheat farmers in the Overberg region of South Africa, there is a growing trend to increase the size of farms in response not only to climate, but also to economic drivers. Correspondingly, there has been a dramatic increase in mechanisation in response to the need to harvest grain more cheaply and in less time. As a direct consequence of increasing mechanisation, the harvesting period has approximately halved (from six to three weeks). These wheat farmers are also intensifying their cultivation practices, through the increasingly precise targeting of chemicals.

Intercropping

Intercropping is a cultivation technique whereby two or more crops are planted in the same field. It has the advantage of allowing greater production from the same land, while not causing additional soil degradation as the two crops will require different nutrients and can be mutually beneficial to each other.

Intercropping was found to be a common response strategy in Malawi, among both small-scale maize and tea farmers. Maize is increasingly being intercropped with pigeon peas, cowpeas, beans, pumpkins, groundnuts, cassava, sorghum and sweet potatoes. Tea farmers are increasingly intercropping their tea with maize as a risk-management mechanism, to ensure that even if one crop fails there is another from which they can make a living.

When drought coping strategies become 'maladaptation'

Focus group discussions in Zimbabwe illustrated the dilemma facing many farmers engaged in rain-fed agriculture: how responding to one weather hazard (drought) can leave them vulnerable to another (flooding). This is an example of how attempting to adapt to climate change and other stresses can lead to maladaptation – practices unlikely to be sustainable in the long run.

Farmers interviewed in Gutu district (Masvingo province) and Chirumhanzu district (Midlands province) reported that while they used to farm in demarcated, arable areas, they have been extending their fields to ecologically sensitive areas including waterways, water chains and "vleis" (seasonal lakes) in search of better soil moisture to cope with drought.

One participant said: "We are now ploughing all those areas that were once forbidden, including dam catchments, wetlands and river beds and stream banks. That's where you find water. No one is observing the distances that need to be kept from the river."

Respondents interviewed in the Old Resettlement Schemes in Chirumhanzu district indicated that they are now planting everything - cereals (maize, wheat and rice); tubers (Irish and sweet potatoes) and vegetables - in their gardens, and have extended their gardens into "vleis". They have abandoned their original arable lands because they have become degraded and dry.

Intercropping tea and maize also increases the efficiency of fertilizers, as both crops can benefit from the same type. The tea growers interviewed indicated that other crops such as cassava and sweet potatoes are being planted around the perimeters of the tea fields.

Dry planting

The necessity to plant with the first rains is leading to the use of dry planting techniques. In Zambia, farmers use cultivation practices such as “dry ripping” using an ox-drawn plough or ripper, hand hoe tillage and planting basins (Twomlow and Hove, 2006). These are now being widely practiced to ensure that most crops are planted with the first rains (early November), rather than allowing the rains to soften the ground first. Respondents in Zimbabwe indicated they dry plant some of their crop so that, to quote one woman, “the rain finds the seed waiting for it in the ground”. They also practise crop rotation to break up monocultures, with different crops able to extract moisture from different soil levels.

4.2 Modifying crop type and varieties

Modifying crops can either involve planting entirely different crop types or using alternative varieties of the same crop.

Planting different crops

While it was traditionally only planted in the south, cassava is increasingly widespread in Zambia as it is drought-tolerant compared to maize and other cereals. Drought-tolerant small grains, such as sorghum and pearl millet, are also being adopted in Zimbabwe.

Planting different varieties

Today, many more seed varieties are available than in the past as a consequence of improved breeding techniques. A number of farmers are turning to hybrid and early maturing varieties as growing seasons shorten and become more unpredictable. It should also be noted from our research that some traditional varieties of crops have disappeared or are little cultivated, with several farmers saying that these traditional varieties are unable to survive the new climates, with shorter rainy seasons and poor rainfall distribution. This lack of fallback makes it crucial that farmers are able to access new varieties, or they will have nothing.

In South Africa, the introduction of new seed varieties has increased yields. Possibly the most widely adopted example is korog (triticale). Korog combines the high-yield potential and good grain quality of wheat with the disease and environmental tolerance (including soil conditions) of rye. Farmers say it is hardier and more drought-resistant and handles all extremes (drought, flood and wind) better than traditional varietals. Some also noted that it could be used for the production of biofuels, although based on the interviews this practice is not widespread.

Small-scale subsistence farmers also try to use new varieties where possible. In Zambia, most local maize and sorghum varieties take about five months (150 days) to mature, but the rain seasons are often shorter than this. Farmers now cultivate drought-tolerant and early maturing improved varieties of maize (which matures within three to four months as opposed to four to five months), sorghum and cowpeas. In Mozambique, several farmers said that with early maturing crops they are able to get two harvests per year, instead of just one. In Malawi, local varieties were traditionally favoured because of their pest-resistance and “poundability”, but researchers found people now describing these as “a source of hunger”, while the early maturing drought-tolerant varieties are known as “hunger removers”.

On the other hand, many new varieties are hybrids and cannot be recycled. This limits the seed available to households for replanting and can create a financial burden by necessitating repurchasing at the start of every season.

Gender roles in agriculture in Zimbabwe and their influence on responding to climate variability and change

Focus group discussions undertaken separately with men and women were used to determine the gendered roles in agriculture and how they have changed over time. In Zimbabwe's pre-independence days, there were gendered crop divisions and labour responsibilities. Men were responsible for the staple crops varidzi vedura, comprising rapoko, pearl millet and sorghum, while women were responsible for the relish side of the diet, comprising ground and round nuts, cowpeas and sweet potatoes. Men would have the preference of land, choosing that which was most fertile for crop production.

Men took responsibility for the physical tasks, including ploughing and digging manure out of cattle kraals, while women planted and weeded together with children. In some cases, men would mark out portions they wanted weeded in a day and if not covered, no one would be allowed to eat that day.

"Men never used to work, they would just peg the land then leave the work for the women and children," the women said.

Women were responsible for harvesting the crop. Men would carry the crop to the homestead, where the women would ensure it was dried and then brew beer for the community. Men, women and children would do the threshing. The women would winnow, while men packed away the harvest. The women were also responsible for processing the grain, roasting, pounding and grinding it into meal.

After independence in the 1980s, women's rights were improved through the formal governance structure. They got national identity documents or the first time, were able to open their own bank accounts (without their husband's identity document), and allowed to inherit their husband's land if he passed away.

"This gave us a lot of freedom and independence as our daughters started going to school more regularly and we benefited from the Adult Literacy programme started by government in this period. We also could read and write. Then roles started to change," said one woman in Chirumhanzu district.

In the 1990s, roles continued to change and in most areas women started enjoying 50% of everything owned by their husbands. Men started getting involved in gardening as they realised there was potential for income generation.

In the 21st century there is a lot of consideration, negotiation and discussion in allocation of roles and responsibilities for all but a few of the households. These equal rights are improving the capacity of women to respond to a changing climate and other shocks and stresses, as they are less vulnerable (relative to men) than they were in the past.

4.3 Resource management

One consequence of a changing climate is a decrease in water available for agriculture. As a result, more efficient resource use and conservation becomes important. Likewise, maintaining soil quality is essential to ensure nutrient availability for optimal production. To these ends, conservation farming is increasingly practised.

Conservation farming

Conservation farming is an approach based on three principles: mulching (leaving crop residues to protect the soil from water and wind erosion, while also regulating soil temperature and reducing evaporation); crop rotation (to allow for replenishment of soil nutrients and minerals, which are taken up in different quantities by different crops); and minimum tillage (a land preparation approach that involves minimal soil disturbance). In general, conservation farming has been shown to improve both agricultural productivity and yields (Hobbs, 2007; Hobbs et al, 2008).

A major advantage of conservation farming is that is does not require substantial inputs and can easily be practised by resource-constrained, small-scale farmers. In Malawi, small-scale tea farmers use mulching grass in the spaces between the plants to preserve moisture for their tea fields. In Zimbabwe, one respondent noted:

> **"It does not differentiate the poor from the rich, because even the poor can dig holes with no problems … and it is very effective in terms of soil and water conservation."**

However, it does require significant physical labour, particularly at the beginning of the planting season and so is not always appropriate for the elderly or disabled.

Large-scale commercial wheat farmers in South Africa have also embraced conservation farming. Here, in contrast to the small-scale farmers in the other Southern African countries, the principles of conservation farming are embraced within a highly mechanised environment, requiring the use of new equipment. So-called "minimum tillage" and "no tillage" approaches involve little or no disruption to the soil by carefully placing seeds and fertilizer in the ground when planting. After harvesting, the wheat stubble is left on the land to protect the soil from erosion. These approaches all conserve moisture in the soil, resulting in more efficient microbial activity, which leads to increased yields.

However, when used in the input-intensive, high-tech environment of commercial farmers, conservation farming is expensive, as new machinery must be purchased for ploughing to ensure minimum tillage of the soil. Some farmers estimate total costs in excess of R1-million to acquire new tractors, ploughing equipment and GPS tracking systems for their land areas. While the main driver of conservation farming among the wheat farmers is to increase yields, it does have the indirect effect of making them more resilient to a changing climate by minimising natural resource use.

Reforestation

In Malawi, there is widespread understanding that human activity is contributing to the challenging farming environment they are now experiencing. There are reforestation projects, especially by the big tea estates, and smallholder farmers have also been planting trees to improve the microclimate and protect against soil degradation.

Micro-irrigation

In Malawi, some small-scale farmers are engaging in micro-irrigation activities in their fields where they cultivate vegetables (in the dry season) and sugarcane. However, the cost of water-lifting devices and irrigation technology can be a serious barrier to many farmers, even if they live near rivers. In Zimbabwe, for example, the consequence of being unable to bring water to the farm is that farmers go to the water, and begin to cultivate sensitive areas along riverbanks and vleis.

▲ Lamion Kwezalamba digging a scoop well in the Nziza River, Malawi. Once a fast-flowing stream, even in the rainy season, water can now only be obtained by digging in the sand. Photograph: Nicole Johnston

The cost of water-lifting devices and irrigation technology can be a serious barrier to many farmers, even if they live near rivers.

4.4 Diversification of livelihood activities

Diversification of livelihood activities has long been accepted as a risk-management mechanism for low-income households, and is becoming increasingly important in the context of a changing climate. In Zambia, trading in agricultural commodities is common, as is micro-enterprise development such as tailoring. In South Africa, a variety of small businesses have been established, including bed-and-breakfast accommodation, restaurants, farm stalls and small art galleries. Management of these tourism-related activities is often by women. Larger-scale wheat farmers said they were diversifying their farm activities (into vineyards, for example, or from grain to livestock) along with tourism and light industrial production.

Rivers of sand

In Mkwezalamba village, Malawi, the villagers mourn the loss of their river. The Nziza River was once a fast-flowing waterway, but now the river bed is a sandy expanse dotted with puddles, even in the rainy season. The only way to get water from the river now is to dig a shallow scoop well. The Balaka Livelihoods Programme has thrown this community a lifeline with a small scale irrigation project that allows them to use treadle pumps to carry water from their river bed to their fields.

"When I was young the Nziza river was always full from December to February, the rainy season. The water would be so high that you could not cross it," says Rosemary Sikochi (60).

"But now the river is dry because the rains don't come. The rains they only come little by little and to get water you have to dig under the sand. Now we have to walk to a borehole to get water and it is very far for me, about 4km away. I can only carry one 20 litre bucket at a time, and we use about five buckets a day for cooking, cleaning and bathing, so I have to make the trip many times a day. My children are grown up and married, so it is just me and my husband at home and no one to help us.

"This irrigation scheme helps with our crops in the dry season. Now we have relish such as tomatoes, mustard leaves and rape to eat with our nsima, even outside of the rainy season. In the dry season we use the irrigation pumps so we can now grow three maize crops a year instead of just one.

"The food prices are going up, but I am old so everything seems expensive to me. When I was a girl, maize was just three cents a cob, now its 30 Kwacha. The prices of sugar, soap and cooking oil just keep going up and up.

Rosemary Sikochi shows off her young maize. Photograph: Nicole Johnston

We are the lucky ones because the irrigation project gives us extra food to sell so we can buy things like that."

5.

BARRIERS TO CLIMATE CHANGE ADAPTATION

How farmers respond to the changing climate is dependent on the capacity of each individual farmer. This can be constrained by numerous factors, such as lack of financial resources, technical know-how and human resources. On the whole, the nature of the barriers differs between small-scale and large-scale farmers.

Farmers are often acutely aware of the limitations to their responses. Identifying the barriers is crucial because building sustainable adaptations to climate will become increasingly difficult as the rate of incremental climate change and the magnitude and frequency of extreme weather events increases.

5.1 Lack of financial resources

Even if they have noticed a decline in their revenue, large-scale farmers still tend to have more access to financial capital than small-scale farmers. Many farmers in Southern Africa, particularly the small-scale ones, live on a day-to-day basis and struggle to meet their financial needs, let alone have the resources to make changes in their activities. Our research shows that lack of financial resources can be divided into three categories: access to credit; cost of improved inputs; and cost of water management.

Access to credit

Lack of access to credit has been observed in previous studies (Nhemachena and Hassan, 2007) to be a barrier to responding to climate change, and the availability of microfinance is still a common barrier to changing activities. Farmers in Zambia cited lack of access to credit as a major determinant of their cropping choices, in turn affecting production levels. In Malawi, a large-scale tea estate manager identified the lack of access to credit as the major barrier to small-scale tea farmers being able to diversify their livelihood activities.

Cost of improved inputs

One of the reasons why accessing credit is so important is because of the cost implications of the improved inputs required to maintain production - fertilizers and other chemicals as well as hybrid seed varieties. For example, in Malawi, small-scale tea farmers have started to plant drought-tolerant tea varieties produced by the Tea Research Foundation in Mulanje-Boma. But, owing to the cost, the only farmers planting them are those who produce for the large tea estates, who have provided them. Other practices to improve yields are also costly: farmers in Zimbabwe observed that large animals are needed for early planting (to reduce time taken for ploughing), which is costly if you have to hire cattle.

Cost of water management infrastructure

With the increasingly unpredictable rainfall across Southern Africa, many farmers would like to introduce irrigation and water harvesting, but are impeded by the cost. One farmer in Mozambique lamented that his farm could easily be irrigated due to its proximity to the river, but he could not afford to do so. Similarly, in Malawi, the smallholder tea growers want to invest in irrigation and water harvesting, but lack the financial capacity.

5.2 Lack of technical know-how

Another common barrier cited by farmers as impeding their ability to respond to a changing climate is the lack of technical know-how.

Lack of technical knowledge

One commercial farmer with 200 hectares interviewed in Mozambique described how he had constructed a water reservoir by damming a nearby river. However, because the development of this infrastructure took place without any technical assistance, it broke in the rainy season. High temperatures, lack of rain and the failure of the investment in the dam meant his 2010/11 crop season was poor and his ability to hire labour reduced.

> **"No employment means no money means no food."**

Not enough government support

Climate change will hit rural communities hard in South Africa. While there is significant policy focus on commercial farming, rural small-scale farmers – particularly women – are often neglected. Government estimates suggest that there are 1.3-million small-scale farming units in the country, and about 70% of South Africa's poorest households live on small-scale farms.

In Malawi, the Smallholders Farmers Association has approached government for an improvement in extension services, to support the introduction of irrigation and water harvesting technologies, and affordable improved seed varieties.

In Zimbabwe, farmers wanted the government to transfer knowledge to assist them in diversification, for example, how to access markets and sell their products, such as vegetables. One farmer observed how the government and other organisations did help, but treated farmers like guinea pigs, introducing them to improved seed varieties, which they liked, and then withdrawing them without consultation:

> **"They regard us as their experiments, they don't ask us what we think about the introduced varieties, whether they should be continued or not. All we see is that variety is out of market the next season."**

Little climate information for decision-making

Another barrier cited by many farmers is the lack of access to adequate climate information that they could use in their farming activities. A common complaint was that seasonal crop calendars are no longer useful because of changes in rainfall onset and distribution. Shorter-term or seasonal weather forecasts could, however, be of more use, but in Mozambique, farmers said that although they listened to weather forecasts, the nearest meteorological station was more than 100km away and so rarely reflected conditions in their area. Likewise, in Sesheke in Zambia, many communities use radio weather forecasts from across the border in Namibia.

In Malawi, smallholder tea farmers said they did not use any rainfall or climatic data. Instead they relied on their collective experience and tips from the large estate extension workers who regularly visited them. In the case of seasonal forecasts, the products are rarely packaged in a format that is accessible and useable for farmers.

Barriers to responding for women

Gender differences in access to resources are common across Southern Africa, and often impede women's capacity to respond to a changing climate, relative to that of men.

In the Sesheke, Kazungula and Sinazongwe districts of Zambia, women are traditionally not able to own land. This is a common situation: in the developing countries where data is available, women account for only 10 to 20% of landowners (Oxfam, 2011a). Furthermore, in Zambia, for married women, access to agricultural loans and participation in community development programmes and income-generating activities are dependent on the consent of their husband.

Even in countries where the constitution enshrines gender equality, patriarchal culture gives rise to distinctive gender roles, which can affect capacity to respond. Women's responsibility for reproductive duties within the household can impede their capacity to respond in the productive sphere (Vincent et al, 2010). Women typically remain physically close to the homestead on a daily basis, to undertake cooking and other domestic tasks. In the longer term, any activities in which they engage (for example, farming and fuel wood and water collection) are also typically close. Men, on the other hand, are less tied to the homestead and, due to a less prominent role in reproductive activities, have the flexibility to migrate in search of paid employment.

▲ A young Malawian girl helps her family look after their crops. Photograph: Nicole Johnston

5.3 Lack of human resources

Human labour constraints can occur due to the out-migration of economically active adults, itself arguably a mechanism for coping with climatic change and stress, or due to chronic illness impeding capacity to undertake physical labour. In some places, being able to access draught animals is crucial to enable farmers to plant early. Yet cattle are suffering from climate changes affecting pasture and water sources, as well as from diseases. Poorer farmers are also less likely to have access to cattle.

In the absence of forecasts how do you predict the weather?

Traditional rain indicators from Zambia

Being able to predict the weather is vital for any farmer in order to plan for upcoming seasons. This is especially true for farmers involved in rain-fed agriculture. Despite living in the valley of one of Africa's biggest rivers, farmers in the southern part of Zambia have very limited access to water from the Zambezi River because they lack irrigation infrastructure. They are therefore heavily reliant on rain to irrigate their staple crops of maize, sorghum and bulrush millet as well as a range of other crops. Local farmers do not receive any form of weather forecast information and have to rely on traditional means to predict the nature of the upcoming season.

There are a number of traditional signs that farmers look for to indicate whether the upcoming season is going to be a good one in terms of rain: swallows appear around October and there is mist on the hills. Another strong traditional indicator of good rains to come is the appearance of dark clouds during the Lwiindi ceremony, a Tonga festival of thanksgiving, which takes place every year in June. The appearance of the "Morning Star" and the star known locally as Danga Balya at dusk, just before the onset of the rainy season (October to April), is also thought to indicate that sufficient rains will come. Lastly, the prevalence of whirlwinds just before the onset of rains is seen as a good sign.

Similarly, farmers use traditional indicators to predict drier than usual rainy seasons. These signs include lower than normal temperatures during the months of September and October and the migration of "black ants" from one point to another. An abundance of wild fruit on the trees Guibartia Coleosperma (Rosewood, traditionally called Muzauli) and Strychnos cocculoides (known locally as Mawi or Tusongole), and the late appearance of fruit on the Baobab tree (Adansonia digitata) are also seen as signs to expect a dry season.

Unfortunately, despite the wealth of traditional knowledge used by farmers in this region to make weather predictions, most households are unable to effectively plan for bad seasons. Although farmers are aware of the need to plant early maturing varieties and drought-tolerant crops, they are constrained by a number of factors, including high poverty levels, limited access to agricultural input loans, economic emigration of active adults in search of better livelihood sources outside the communities, and poor infrastructure development and marketing systems.

6.

OTHER MULTIPLE STRESSES IN THE FARMING ENVIRONMENT

Dorothy Shilling shows off the sweet potatoes grown in her backyard food garden in Bulawayo, Zimbabwe. Photograph: Nicole Johnston

A changing climate is one of a number of "multiple stresses" that affect food production, and these stresses interact in different ways in different places. Many of the responses listed above, although they may be driven primarily by climate factors, can also be driven by other stresses. Diversification, for example, can occur in response to a change in economic policy, as well as repeated failures of a rainy season. Other stresses include HIV and AIDS, an uncertain economic environment as a result of greater global economic integration, and political and policy changes. The 2008/9 increases in fuel prices linked to the financial crisis, for example, pushed up the price of fertilizer and thereby rendered many small-scale farmers in Malawi more vulnerable to weather-related hazards in that season.

Women are typically burdened by caring for the sick, which can in turn impede their ability to produce or purchase food, creating a vicious circle.

6.1 HIV and AIDS

Southern Africa has an extremely high prevalence of HIV and AIDS, with rapidly growing numbers of HIV-infected people, particularly in South Africa and Mozambique. The relationship between HIV and AIDS and climate change can be "two-way" and, at its worst, result in double exposure and an overall increase in vulnerability. Infection with HIV makes people more vulnerable to changing climatic conditions (which as we have seen include higher temperatures, more drought and erratic rainfall and are therefore less benign), as sufferers are less able to cope with reduced food intake and to pursue the flexible livelihood strategies required to, at least, cope (Drinkwater, 2005). Exposure to a changing (worsening) climate can also increase people's exposure to HIV, although the relationship is arguably weaker and requires further research. Women may engage in transactional sex as a coping mechanism in the face of food insecurity (Weiser et al, 2007, ActionAid, 2006).

A study of child malnutrition in relation to the HIV epidemic and drought (crop years 2001/2 and 2002/3) in six countries of Southern Africa found a strong correlation between HIV and drought (Mason et al, 2005). The study concluded that the combined effects of future droughts and HIV could have a significant impact on child nutrition in badly HIV-affected areas. People living with HIV need extra nutrition and so when climate change reduces food production, they are more seriously affected. Extreme events such as floods can lead to cholera outbreaks, to which people living with HIV and AIDS are more susceptible. Damage to health infrastructure (including home-based care) may impede their access to antiretrovirals, and sound nutrition is a prerequisite for optimal performance of antiretrovirals.

Women are typically burdened by caring for the sick in such circumstances, which can in turn impede their ability to produce or purchase food, creating a vicious circle. Farmers in Zambia in particular, mentioned how high numbers of orphans place a particular burden of care on grandparents.

6.2 Uncertain economic environment

Whether farmers are producing food for their own consumption or for the markets, the economic environment affects their activities.

In Malawi, markets have been a clear driver of change in the farming environment. Tea is increasingly taking over from tobacco as the main cash crop, due to declining demand for tobacco. The economic production system for tea is based around large-scale commercial tea estates in Mulanje and Thyolo districts, which also purchase produce from smallholder farmers for processing to serve the domestic and export markets. Until the mid-1990s, smallholder farmers used to sell their produce to a smallholder tea authority, however, bankruptcy in 1994 meant they had to find new markets. They began to sell to large estates, which are increasingly monopolising the industry, while there is little representation for the large number of smallholders. While this research was being done, prices for green leaf tea paid to smallholders had dropped as low as MK19.5 per kilogram. Low prices impede the ability of smallholders to employ seasonal labour during peak periods (December and January) and reduce the affordability of fertilizer. This makes it harder for farmers to respond to a changing climate.

At the other end of the spectrum, large-scale commercial wheat farmers emphasised how the economic context is the primary driver of their decision-making. Adoption of conservation farming, increasing farm size and the increasing application of technology are all responses to the need to produce more. Diversification is driven by the need to spread risk away from the volatile international markets, where wheat is traded. Increased mechanisation is affecting the labour demand: the need for skilled labour (to operate machinery) is increasing, but overall the demand for farm labour is decreasing. This causes growing levels of unemployment among farm labourers. Neither commercial farmers nor state or private training institutions are providing the skills development and training needed to meet the growing demand for more skilled labour.

6.3 Political and policy changes

Political and policy changes in the farming industry over time have affected the capacity to respond to a changing climate. Each country has a very different context and history: Malawi and, to a lesser extent, Zambia, have a long history of government support to small-scale producers, with a series of input subsidy programmes – although there have been problems in ensuring access by all farmers. Mozambique gave priority to large-scale state farms at the expense of smaller scale producer cooperatives, although this is now being rectified; the Strategic Plan for the Agriculture Sector Development 2011-2020 has as its main objective to stimulate the productivity of, and production by, small-scale producers. The transition to democracy in South Africa has been reflected in an expansion in recognition of farming types, taking into account the fact that commercial farming is an important source of food production for the entire region, while also recognising the number of small-scale farmers and their critical role in rural food security. However, it must be recognised that the systems required in South Africa are not necessarily in place to implement the policy to support small scale farmers. Arguably, the country where political and policy changes are most affecting farmers and crop production is Zimbabwe. Agricultural policy itself changed from the colonial period (where large-scale commercial farmers were supported) to independence (where small-scale subsistence farmers were supported) to the post-independence period (where the focus has been on land redistribution).

7.

CONCLUSIONS

A woman sells her produce in Matobo district, Zimbabwe. Photograph: Nicole Johnston

Southern Africa is characterised by climate variability, but, as we have seen, both temperature and rainfall records, as well as the observations of farmers, suggest that the effects of man-made climate change are becoming apparent.

A number of strategies are being adopted in response to a changing climate and other pressures. These include changing farming practices, modifying crop type and varieties, resource management and diversification.

There are differences between coping and adaptation, and this has policy implications. Coping strategies tend to be short-term, temporary and employed to ensure immediate survival in a crisis. Coping strategies employed by farmers interviewed included receiving emergency food assistance from governments and/or NGOs, or temporarily migrating. Coping strategies do not reduce vulnerability in the face of exposure to a hazard. Genuine adaptation strategies do reduce vulnerability, so that when exposed to the same hazard in the future, the consequences are not so adverse.

Defining and supporting adaptation practices and adaptive capacity, and the resources and methods to promote and strengthen both of these, are crucial, as are identifying barriers to adaptation. Some of the strategies that farmers are currently pursuing, and which this report has identified, may be appropriate and successful examples of adaptation to climate change rather than merely coping. These include intercropping, increasing crop diversification, conservation farming, reforestation, micro-irrigation and water harvesting. These can all be strengthened and expanded, as can people's capacities to undertake them.

However, the research also identified barriers to adaptation, particularly for small-scale farmers. Adaptation to climate change, and ensuring food production in a changing climate, is more likely when general sound development principles for a pro-poor, pro-growth development agenda are observed (Nelson et al, 2009). Similarly, in many cases the policy frameworks exist, but to ensure their optimal utility, they must be effectively implemented.

As seen previously, price rises under climate change may be extreme. However, the model developed by Willenbockel also runs the information under an "optimistic" agricultural productivity and growth scenario, which assumes intensive research and development, technology transfer and concerted efforts to raise yields among smallholder farmers.

Under this optimistic scenario, prices in 2030 could be kept to only minimally above 2010 price levels for paddy rice and wheat. Price rises for maize could be limited to just over 10% and, for processed rice, to just more than 20% relative to 2010. This analysis suggests that high food prices under climate change need not be inevitable – but, of course, to achieve this scenario, substantial commitment and investment needs to be made in adaptation now.

Genuine adaptation strategies reduce vulnerability, so that when exposed to the same hazard in the future, the consequences are not so adverse.

A young Zimbabwean woman preparing food. Photograph: Nicole Johnston

8.

RECOMMENDATIONS

Beneficiaries of a cash transfer scheme in Chitimbe village, Malawi. Photograph: Nicole Johnston

8.1 Act to prevent dangerous climate change at COP-17 in Durban, South Africa, and then beyond

The impacts of climate change will inevitably become more severe in the future as global average temperatures continue to rise. But the scale of temperature increase faced by future generations will depend on the urgency, ambition and stringency of commitments made under the United Nations Framework Convention on Climate Change (UNFCCC) to reduce global greenhouse gas emissions. Furthermore, the impact of climate change on the poorest and most vulnerable can be lessened if sufficient, new and additional flows of public finance are mobilised to help people in developing countries to adapt. COP-17, the forthcoming 17th Conference of the Parties to the UNFCCC in Durban at the end of 2011, must take major strides to address these issues.

First, governments must agree measures to close the emissions gap between the pledges of greenhouse gas emissions reductions made to date, and what climate scientists indicate is needed to have a good chance of keeping global warming below 1.5°C. In Durban, rich countries should at least commit to the upper end of the ranges of cuts they have pledged to date, and governments should agree a pathway to move beyond them so that each country does its fair share of the global mitigation effort. In addition, stringent common accounting rules must be agreed to monitor emissions and close current loopholes, and major sources of rising emissions – such as those from international shipping and aviation – must be regulated.

Second, governments must mobilise sources of substantial long-term climate finance to help developing countries to adapt and embark on low carbon development paths. In Durban, rich countries must agree a roadmap for scaling-up climate finance from 2013 to 2020 to at least meet the promise by rich countries to mobilise $100-billion per year by 2020. It is vital that these resources are additional to existing promises of development finance, such as for health and education. They should be raised both from budget contributions of rich countries and from supplementary sources of public finance, such as carbon charges on international shipping and aviation. Governments in Durban must also take key political decisions to operationalise the Green Climate Fund established at last year's COP-16 in Cancun, Mexico. These should ensure that the Fund has principles of gender equity at its heart, delivers at least 50% of its resources to adaptation, and puts developing countries in the driver's seat for how resources are spent on the ground. Civil society – particularly organisations of vulnerable groups, such as women's organisations and associations of smallholder farmers – must participate fully in the governance of the Fund from the global to national levels.

Third, governments must ensure that the international climate change regime is legally binding. COP-17 represents the final opportunity to agree on a second commitment period to the Kyoto Protocol and, in keeping with the recent Southern African Civil Society Forum pledge, member states of the Southern Africa Development Community (SADC) should stand firm on the African position that a second commitment period of the Protocol is an essential outcome of the Durban conference. But governments in Durban must also agree that a legally binding agreement is needed to cover countries such as the United States, which are not part of the Kyoto regime, and to put agreements on finance, adaptation and the actions to slow emissions growth in developing countries on a legal footing. While it will not be possible to finalise this comprehensive, legally binding agreement in Durban, governments must agree that this is the end point of their negotiations and set a timeline by which they must be concluded.

Photograph: Neo Ntsoma

8.2 Support agriculture — increase funding and improve policies

The most fundamental changes required to support ongoing food production in the context of a changing climate are modifications to agricultural policies to enable and support adaptation, and directing more resources towards agriculture, especially to small-scale farmers. The opportunities for improving agriculture within the context of a changing climate should be seized. The advantage of many adaptation options, including the majority of those outlined here, is that they are "win-win". No matter how the climate changes, they would still have positive developmental, and often environmental, impacts. The Comprehensive Africa Agricultural Development Programme (CAADP), established in 2003 in Maputo by the African Union (AU) under the leadership of NEPAD, aims to support African countries to reach a higher path of economic growth through agriculturally led development that eliminates chronic hunger, reduces poverty and food insecurity. The Maputo Declaration in 2003 saw all member countries of the AU commit to increase the share of agriculture in national budgets to at least 10%. However, of Zambia, Zimbabwe, Mozambique, South Africa and Malawi, currently only Malawi is reaching this target (although Zimbabwe has reached it previously). The resulting increase in food production per head shows that investments in agriculture do pay, but there is still much work to be done. Currently less than 7% of overseas development aid is devoted to agriculture (Oxfam, 2011a) and this clearly needs to increase.

Substantial international funds have been made available for adaptation to climate change outside of those associated with the UNFCCC, and Africa has been earmarked as being particularly in need. To date, however, the extent to which governments have honoured the pledges they have made has been variable (Ballesteros et al, 2011). Given the controversies around accessing and using these funds, it is critical that the governments of Southern African countries identify the most pressing adaptation needs and ensure that adaptation finance is targeted towards those nationally driven needs (Oxfam, 2011b).

8.3 Areas to focus on

Farmers interviewed for this report highlighted the following areas to focus on:

Support seeds research and dissemination

Farmers across Southern Africa spoke of the value of early maturing varieties of seed, and even hybrids, in ensuring a decent harvest in the face of changes to rainy seasons. This is backed up by the study by Lobell et al cited earlier, which says: "Not all maize varieties will respond similarly to climate change, and indeed, shifting varieties represents a key potential means of adaptation … agronomic measures to improve soil moisture and breeding efforts to produce drought-tolerant crops are not only beneficial for managing present and future risks of drought, but are also probably important strategies to deal with future warming." However, the cost (and often availability) of such seeds means that they are often out of the reach of small-scale farmers. There are also complaints about quality. A number of donor-funded projects in the region have begun to support seed multiplication activities among small-scale farmers, providing a once-off input and then setting up the institutions required to sustain the availability of such seed varieties. Governments should also promote availability through subsidies. A farmer in Zimbabwe observed,

> "There is need to enforce the Seed Act so that seed is sold by approved dealers not by just anyone who may be tempted to paint grain and sell it to us."

Support through subsidies

A number of African countries already have subsidy programmes for small-scale farmers, notably Zambia and Malawi. In recent years, these programmes have contributed to increasing production levels and higher likelihoods of food security. Such programmes need to be scaled up, and deliveries of seed, fertilizer and other inputs need to be reliable, timely and close to where farmers live.

Support social protection

For poor farmers, the most promising interventions are not always within agriculture, according to an Oxfam report (Oxfam, 2009, "Investing in small farmers pays"). Safety nets are needed to help them cope with shocks and prevent them from making irreversible decisions with long-term consequences to meet short-term needs. When poor people barely have enough to meet basic needs, shocks can lead to harmful cuts that affect long-term household welfare: illness left unattended; children pulled out of school; and worsening diets. When forced to make choices to meet short-term needs that ultimately undermine the capacity for future productivity, poor people can be pushed even further into poverty. Social protection needs to be at the forefront of interventions to reduce poverty in order to help poor people access food and other basic needs during hard times, and to assist those who are unable to engage in productive activities consistently due to impediments such as old age, ill-health or disability. Members of the AU have taken note of rapidly accumulating evidence of the positive potential impacts of social protection, in the form of cash transfers. Evaluations in Lesotho, Malawi, Mozambique, Swaziland, South Africa, Zambia and Ethiopia all confirm that cash transfers, while used mainly for meeting basic needs (food, groceries, health), are also used for investment (education, agriculture, business) and, in contrast to food aid, cash transfers stimulate production, trade and markets (African Union, March 2006, Livingstone, Zambia, cited by Sahel Working Group, September 2011).

The spread of mobile telephony is a significant opportunity for farmers and extension workers to work together more effectively.

Ensure adaptation is gender equitable

Although gender considerations are given more recognition now than in the past (Holmes and Slater, 2008), there is still more to do to ensure that both women and men have equitable access to adaptation options.

Many policies and programmes fail to consider gender implications, meaning that the relative situation of men and women remains entrenched. When considering food production it is particularly important to pay explicit attention to women, since many farmers are women. In Zambia, Kenya, Tanzania and Burkina Faso production could increase by between 10 and 20% if land, labour, capital (and fertilizer) was equally allocated between men and women (IFAD, 2008) (and see "support and invest in women farmers").

In particular, climate finance mechanisms, such as the Green Climate Fund, must explicitly meet the needs of women, as current climate finance institutions almost entirely ignore gender issues (Oxfam, 2011c). They must incorporate gender analysis throughout project design, implementation, monitoring and evaluation.

The national climate change strategies of governments in the region must also have gender-specific objectives, indicators and data to measure and ensure the equitable delivery of finance to women and men.

Governments in SADC should develop an addendum to the SADC Protocol on Gender and Development that reflects the gendered aspects of climate change.

Women's participation and opportunities for leadership must be assured at all levels of climate policy and climate finance development. Participation in the development and implementation of a post-2012 climate agreement should be gender-balanced and include women leaders, gender experts and women's affairs ministers in decision-making processes at all levels. Women, and women's networks, should be recognised as important stakeholders and empowered to participate in climate fund consultations. Civil society should increase the capacity of poor women to directly access information and contribute to the process of effectively distributing climate-related information in their communities.

Support extension work and technical knowledge creation and transfer

Technical knowledge is crucial to ensure greater efficiency and higher production yields per farmer. Many farmers have chosen to change the crop type or variety that they grow – but others observe that lack of knowledge on what other varieties to try, and how to plant them, is an obstacle. Unfortunately, extension services from departments of agriculture across Africa have typically been reduced over recent years in response to budget cuts. But increasing the availability of extension officers is critical to transfer the knowledge necessary for farmers to respond to climate change. Training is required in crop-production technologies and innovations appropriate to the changing climate, such as new, early maturing seed varieties. Extension workers also need to be made aware of climate change and trained on how to communicate it and what to do about it. The spread of mobile telephony is a significant opportunity for farmers and extension workers to work together more effectively.

Support climate information and weather forecasting

Another field of knowledge that needs to be transferred is climate information. National meteorological and hydrological services in all SADC countries generate seasonal forecasts, which predict the likelihood that rainfall over a

three-month period will be average, above average or below average. Often, this information is not communicated to farmers, who could use it to influence their crop choice and time of planting (Coe and Stern, 2011). Despite worries that small-scale illiterate farmers may not understand the probabilistic nature of the information, a series of experiments in Zimbabwe showed that this was not the case (Patt et al, 2005). However, farmers in Zambia said that even if they did have much better forecasts available, their decision on what to plant would depend directly on their financial status and the availability of inputs.

Support farmers' collective voice and action

The ability of individual small-scale farmers, often poor, to articulate their needs and demands and use their economic power and political rights, is constrained by lack of collective organisation. In Malawi, farmers believe that their individual voices are inadequate relative to the commercial tea growers, and want to establish an umbrella body to coordinate and improve the likelihood of them being able to bargain with large tea estates relating to prices paid for tea.

In Nampula province, Mozambique, the Nacaroa Agriculture Forum is a collection of seven different farmers' associations, including one comprising women farmers. Farmers belonging to this forum cultivate peanuts, maize, cassava, sesame and pulses, much of these being sold to large commercial companies. The forum has been successful in helping farmers to get better prices by providing market information. Member farmers also note that their yields of many crops have increased. Part of the reason for the success of this forum is due to initial support and training provided by World Vision in 2000, and Africare, which continues to provide extension services.

Support and invest in women farmers

The Oxfam study on investing in small farmers referred to above showed that although women are key to food security for their households, investments in food production typically target men rather than women. This is because it is assumed that knowledge will be shared throughout the family. Yet, often this information is unsuitable for women's needs. Technology adoption, for instance, depends on many factors, sometimes unrelated to the technology itself. Access to resources such as land, credit, inputs and information are often lacking. So, even if a woman has access to her own plot, yield differences are imperceptible if other constraints are not addressed first. Female farmers, especially female-headed households, often are not contacted by extension services. The World Bank found that in Zambia, for example, if women enjoyed the same overall degree of capital investment in agricultural inputs, including land, as their male counterparts, output could increase by up to 15%.

Support small-scale irrigation and better water management

The most evident need to ensure food production in the context of a changing climate in Southern Africa is water management. The first approach to water should always be to strengthen natural processes and manage resources appropriately to protect supplies; strengthen and re-establish natural buffers and systems increasingly exploited by agriculture, including riverbanks, floodplains and wetlands; adapt practices to require less water and/or conserve more water; and change behaviours to decrease water waste.

Irrigation systems, comprising dams, channels and pumps (and possibly boreholes), can improve yields and are a vital part of many commercial farming operations, but rarely available to small-scale farmers. In the research for this report, we interviewed numerous farmers who have farms near rivers such as the Zambezi and would like to irrigate their land, but cannot. Small-scale irrigation facilities, such as those provided by Oxfam or partner agencies in Zimbabwe (see box) or southern Malawi, give massive boosts to the productivity of small farmers.

However, with climate change happening, the sustainability of water resources in any one context must be examined before irrigation is installed. Drilling boreholes without due consideration for the rate of groundwater recharge could result in a situation of maladaptation, with farmers relying on a resource whose availability in the future is not secured. Similarly, water is under considerable demand, and mass extraction from rivers is likely to have consequences, either for other human uses or for flora and fauna. If it is not possible to undertake the necessary analyses, a less risky option is to encourage water harvesting.

Ipaishe Masvingise proudly surveys her land. Photograph: Annie Bungeroth/Oxfam

Water management and food production in Zimbabwe

Ipaishe Masvingise (46), a widow and woman farmer on an Oxfam-supported irrigation scheme in Gutu, Zimbabwe, says: "I come from a long line of farmers, but it's unusual for women to own land so it's just been a dream. Our land was fertile and we used to get good harvests but then the weather changed, the rain is really erratic. You work and work, but get nothing back if there's no water.

"With Oxfam and the government we worked together and cleared shrubs, trees, levelled the ground, laid the pipelines and irrigation canals, built toilets and set up drinking points.

"For the first time, I was given my own land to work on. Now [September 2011] there's a transformation. Now with water I have two crops already, it gives me more than enough food and I can sell the grain to pay for fees, medical bills, pay for help in the fields and even support my extended family who don't have their own land."

A young boy herds cattle in Malawi. Photograph: Nicole Johnston

Water management is often interpreted as purely being about infrastructure, but both the right policies for ongoing support and behavioural adjustments play as important a role. Infrastructure is only one aspect of successful water management and, on most scales, the least important. Without successful systems for operation and maintenance, infrastructure will crumble and fail within a few years. Yet many authorities fail to recognise the necessity or budget for recurrent costs. Still fewer invest in building up community ownership and management structures where these are essential for village-level management of water systems, and the basis for more widespread management structures. Professor Richard Carter, Head of Technical Unit, WaterAid, has said the true costs of providing reliable water services have been put at 20:80, where 20% represents the upfront cost of investment in infrastructure and 80% the often-neglected cost of keeping the service running.

Integrated Water Resource Management (IWRM) offers ways to manage water at multiple levels and across geological basins and political boundaries, and there are means to downscale IWRM to empower communities to manage water resources, including skills and techniques to monitor water flows in response to climatic changes (Appropriate Development Panel of the Institution of Civil Engineers, Oxfam and WaterAid, forthcoming 2011).

Support animal draught power

For the majority of small-scale farmers who lack access to tractors, being able to use cattle or other draught animals for ploughing is crucial to enable them to plant early and plant enough. Yet cattle are suffering from climate changes affecting pasture and water sources, and from diseases. National governments should invest in better veterinary service coverage within agricultural investment programmes, and in disaster risk reduction and restocking programmes when necessary.

Support road building

Improved telecommunications, and the widespread use of mobile telephones, means that informational connections with markets are easier than in the past. In Zambia, for example, a successful International Fund for Agriculture (IFAD) scheme, in conjunction with the Zambia National Farmers' Union, made available commodity prices to farmers for the cost of a text message. However, this means little if the ability to transport produce is still impeded by substandard roads. Along with lack of access to price information, credit and storage, lack of transport facilities mean markets are often fragmented and fail to function properly, which increases the space for some traders to assume dominant positions in setting local prices, to the detriment of small-scale farmers (Sahel Working Group, 2011). Recent analysis on Mozambique found that investment in roads was one of the primary adaptation strategies (Arndt et al, 2010).

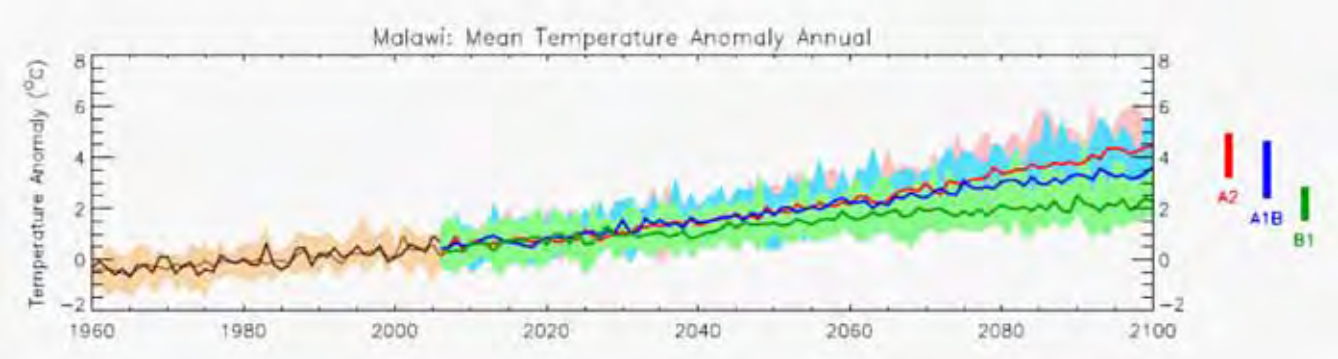
APPENDICES

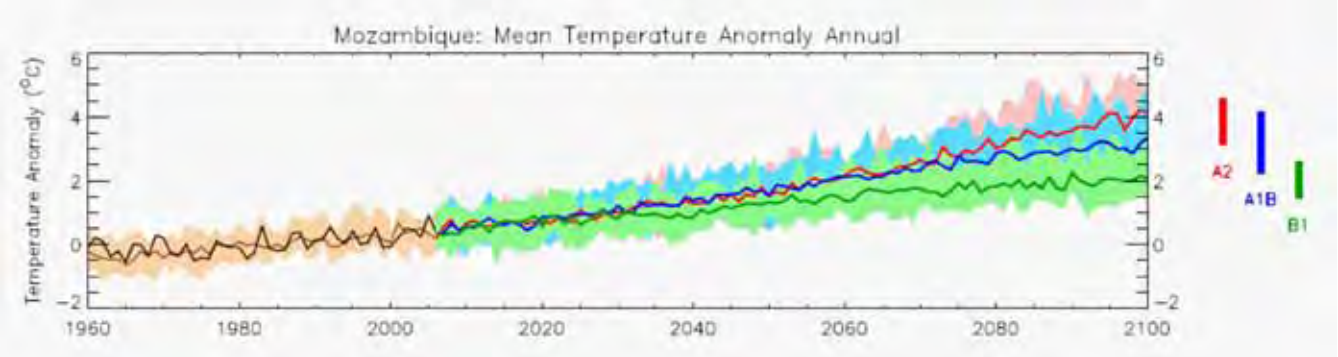
APPENDIX 1: Summary of research locations, predominant crops and farming type

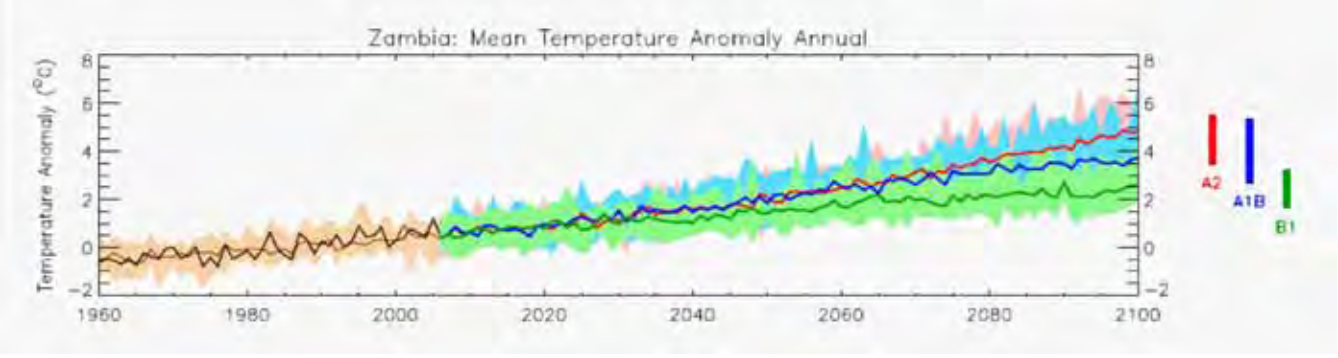
Country	Research locations	Predominant crop	Farming type
Malawi	Balaka district	Maize	Small-scale, predominantly subsistence
	Mulaje and Thyolo districts	Tea	Small-scale contract farmers
			Large-scale commercial
Mozambique	Meconta, Namiala and Monapo, Nampula province	Maize, rice, sesame, peanut	Small-scale commercial
South Africa	Overberg region, Western Cape	Wheat, barley, oats, canola, korog, lucerne	Large-scale commercial
Zambia	Lusu East Agricultural Camp, Sesheke district	Maize, sorghum, millet, groundnuts, cowpeas, beans, cassava and sweet potatoes	Small-scale, predominantly subsistence
	Sinazeze Agricultural camp, Sinazongwe district		
	Kasaya Agricultural camp, Kazangulu district		
Zimbabwe	Gutu district, Masvingo province	Maize, sorghum, millet	Small-scale, predominantly subsistence
	Chirumhanzu district, Midlands province		

APPENDIX 2: The climate of Southern Africa

Detailed analyses of observed and projected climate change for Malawi, Mozambique and Zambia are available through the United Nations Development Program (UNDP) Climate Change Country Profiles database These country-level assessments combine several sources of observational climate data with projections of climate change based on the World Climate Research Program Climate Model Intercomparison Project-3 (WCRP CMIP3). The CMIP3 database combines an extensive range of Global Climate Model (GCMs) projections, and was used as the basis for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4, see IPCC, 2007). In 2000, the IPCC created a "family" of socio-economic scenarios, each representing a potential future based on different possible emissions levels (IPCC, 2000). The A2, A1B and B1 scenarios used here, provide a range of climate change estimates under high, medium and low-emission scenarios, respectively.







Summaries of primary research locations and methods

The aim of this research was to look at a range of different farming types (small-scale and large-scale, subsistence and commercial producers), and representatives of these various categories were purposefully chosen.

Different people carried out the research in each country, which was qualitative and guided by an interview or focus group discussion schedule of relevant questions, while at the same time giving researchers the flexibility to explore different emerging themes. Researchers were also encouraged to conduct key informant interviews with relevant people in the sector.

This appendix provides some more methodological information on the fieldwork conducted in the various countries. In total, over 200 farmers took part in the interviews for this research.

South Africa – research by Alec Joubert

After maize, wheat is South Africa's second-most important cereal in terms of aggregate production. Wheat was chosen to balance the focus on maize farmers in the region.

Due to the specific climatic requirements for wheat growth, the crop is only grown in the Western Cape province of South Africa. Based on advice from the provincial department of agriculture, and an initial contact, "snowball sampling" was used to identify eight large-scale wheat farmers for interview. An additional key informant interview was undertaken with an agricultural economist who works with wheat farmers in the region.

Zambia – research by Petan Hamazakaza

The study focused on the valley region of Zambia (agro-ecological zone I, in the Southern and Western Province), the area worst affected by climate change. Within the region, three districts were purposefully sampled: Sesheke (Lusu East Agricultural Camp), Kazungula (Kasaya Agricultural Camp) and Sinazongwe (Sinazeze Agricultural Camp). The three areas were chosen due to their contrasting environmental factors and varying farming systems, the importance of agriculture to the livelihoods of the rural population, and dependence on livestock production and rain-fed cropping, which is highly reliant on weather factors. Crops farmed include maize, sorghum and millet, as well as groundnuts, cassava and cowpeas.

Two focus group discussions, one with men and one with women, were held in each of the three agricultural camps. Each group comprised between 12 and 20 participants.

Zimbabwe – research by Charity Mutonhodza

Research was undertaken in the Gutu and Chirumhanzu districts of Masvingo and Midlands provinces. Both districts are in Natural regions III and IV and fall in three livelihood zones, namely Cattle and Cereal Farming, Central and Northern Semi-Intensive Farming, and Masvingo Manicaland Middleveld Communal. The focus was small-scale, predominantly subsistence, farmers of maize, sorghum and millet.

Five wards were selected in consultation with the Zimbabwe Oxfam Country Office and the district AGRITEX. Two focus group discussions were conducted in each of the five sampled wards, one each with men and women, except for one site in Gutu district where the men were reported to have gone for beer drinking.

Key information interviews were conducted with village heads, councillors, extension officers, staff in Oxfam, the Ministry of Agriculture and the Department of Meteorology. Relevant baseline statistics (demographic, agricultural productivity, climate data) at district and national level were collected and analysed.

Malawi – research by Diana Chanika

Primary research was conducted with tea and maize farmers.

Tea is increasingly becoming one of the major cash crops in Malawi. It is a high altitude crop, largely grown in Mulanje and Thyolo districts in southern Malawi. Tea is a major source of livelihoods for the majority of the people of Mulanje and Thyolo districts. They either grow tea (as smallholder tea farmers), or work in the large tea estates (either as permanent staff or temporary or casual labourers) to earn their livelihoods.

Seven smallholder tea farmers and the secretary of a smallholder tea growers committee were interviewed. A semi-structured key informant interview was conducted with a tea estate manager, and two focus group discussions were held with farm

▲ Teenagers sell fruit and vegetables in Mozambique. Photograph: Neo Ntsoma

labourers in Mulanje (one group of eight women and one group of six men).

Maize remains the major food crop for the majority of the population in Malawi and is grown in all the districts by all smallholder farmers for both household consumption and sales. Balaka district was selected for this study. Two focus group discussions were conducted, one with six men and one with five women.

All the respondents were selected based on their willingness and flexibility to grant an interview with the researchers. This was particularly an issue at the large tea estates, where only the one large estate manager was willing to grant an interview, but wished to remain anonymous.

Mozambique – research by Eulalia Macome

Research was conducted with small-scale commercial farmers in various districts of Nampula province (Meconta, Namialo and Monapo). Nampula province is located in the northern macro-agro ecological zone, which used to be less vulnerable to drought as rain is well distributed and more stable. Focusing on maize and/or rice and/or sesame and/or peanuts, six different farmers were purposefully selected for in-depth interviews, with help from Clusa, an NGO working with farmer organisations in the province. Two sites were visited (with limitations imposed by the fact that research took place at harvest time). Farmers in the area are mostly market-oriented and supply to the deficit areas in the south. A key informant interview was undertaken with Nacaroa, a farmers' organisation in the city of Nampula.

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