# Farmers' risk perceptions and adaptation to climate change in Lichinga and Sussundenga in Mozambique

**O.J. Chichongue[1,2], G.N. Karuku[1], A.A. Mwala[2], C.M. Onyango[2], A.M. Magalhaes[1]**

[1]University of Nairobi and Agricultural Research Institute of Mozambique (IIAM)
[2]University of Nairobi

**Abstract**

A study was carried in two villages of Lichinga and Sussundenga Districts in Mozambique to assess the perceptions of smallholder farmers to climate change and adaptation strategies. Using data obtained from a farmer survey, descriptive statistics analysis was undertaken using SPSS Version 16. Results indicate that farmers from both districts cited rainfall variability and higher temperatures to have severely affected maize production. Due to the late onset of rains, in Lichinga, the planting period has changed from November (47.5%) to December (70%), while in Sussundenga the planting period has changed from September-October (40%) to November (62.5%). The rain seasons have become shorter and dry seasons longer. It is concluded that differences in perceptions of climate events differ within the two districts and diversification through raising adapted crops and having off-farm income significantly reduce climate risk perceptions. It is also recommended that adaptation strategies should support farmers' livelihood diversification and off-farm farm income risk management strategies.

**Key words:** climate variability, farmers' perceptions, adaptation strategies.

## Background

Climate variability and droughts are important stress factors in Africa, where rural households have adapted to such factors for decades (Mortimore and Adams, 2001). Historical data shows that the continent is already undergoing climate change. The continent is becoming warmer and drier. Rainfall is becoming less predictable. Meanwhile, storms, droughts and floods are becoming more common and intense (Ehrhart and Twena, 2006). In Mali, Lacy *et al.* (2006) revealed a tendency for a shortening of the rainy season to induce farmers to shift some of their sorghum production to a variety with a shorter cycle than the traditional one. In Burkina Faso, Nielsen and Reenberg (2010) found rainfed cereal production to be declining due to a change in climate and a shift towards a higher level of dependence on migration, livestock, small-scale commerce and gardens. Recent events, such as the poor rains in Southern Africa 2001-2013, demonstrate that communities may already be suffering the consequences of less predicTable weather patterns (Wiggins, 2005).

As the poorest country in Southern Africa – a region that is projected to become substantially hotter and drier – Mozambique is likely to feel the impacts of climate change more than most countries in the southern Africa (Ehrhart and Twena, 2006). The most striking impacts of climate change over southeastern Africa are expected to be an increase in the frequency and severity of extreme events such as droughts, floods, and cyclones (Ribeiro and Chaúque, 2010); all of which are expected to become more frequent, intense and unpredicTable (IPCC, 2001).

Climate variability directly affects agricultural production since agriculture is inherently sensitive to climatic conditions and is one of the most vulnerable sectors to the risks and impacts of global climate change. Climate change will affect food security by reducing livelihood productivity and opportunities in Mozambique (Ehrhart and Twena, 2006). Research by the Government of Mozambique suggests that mean air temperatures will rise by at least 1.8-3.2° C nationwide by 2075 (MICOA, 2007). Precipitations are predicted to fall by 2-9%, which will take greatest effect between November and May. As this coincides with the growing season, it will have an especially pronounced impact on crop yields (Ehrhart and Twena, 2006). Harvest failure and incidents of food insecurity in Africa have become regular events occurring at least once or twice every decade (Eriksen, 2005).

Over time, rural households develop various coping strategies as a buffer against uncertainties in their rural production induced by annual variations in rainfall combined with socioeconomic drivers of change (Cooper *et al.,* 2008). Coping strategies may be preventive strategies such as altering planting dates, introducing other crops and making investments of water equipment, or may be in-season adjustments in the form of management responses (Trærup, 2010). Farmers can adapt to climate change by modifying the set of crops planted and their agronomic practices (Blanc, 2011). The latter most often include consumption smoothing, sale of assets such as livestock, remittances from family members outside the households and income from casual employment (Niimi *et al.,* 2009).

While extensive research on the impacts of climate change has tended to focus on impacts on country level, less effort has been directed at developing adaptation strategies at individual households and little has been done on the farmer risk perception. There is, thus, need to investigate the farmer risk perception and adaptation to climate change on agriculture in Mozambique at the individual household level, considering that agriculture remains the backbone of the country's economy. This study seeks to contribute to the body of research on climate change by investigating the vulnerability of smallholder farmers in Mozambique.

**Methodology**

***Study site***

The study was conducted at Lichinga and Sussundenga Research Stations in Mozambique (12° 30′ to 13° 27′ S; 34°50' to 35°30' E at 1000 m). The agricultural production in two is predominantly rainfed and receives unimodal rainfall (MAE, 2005a,b). Lichinga Research Station is located in Lichinga District to the West of the Niassa province and lies along. The rains occur between November and April ranging from 900-2000 mm per annum. The temperature ranges from 16.1-32.9° C with an annual average of 22.9°C (MAE, 2005a). The soils are ferralsols according to FAO (2006) soil classification system.

Sussundenga Agrarian Research Station is located in Manica province, central Mozambique and lies on 19°20′ S; 33°14′ E, with an altitude of 620 m. The rains occur between November and April with average annual of 1,155 mm (MAE, 2005b). The average minimum temperature is 9.5° C in the month of July and average maximum is 29.1° C in the month of January, giving an annual average of 23.0° C (MAE, 2005b). The soils consist of ferralsols, lixisols and acrisols according to FAO (2006) soil classification system.

***Data collection procedures***

A household survey was conducted in Lichinga and Sussundenga Districts of Mozambique to evaluate the farmers' risk perception and adaptation to climate change. Two villages were randomly sampled from each of the selected Districts. The survey was carried out at Lichinga District from 16-17 February and at Sussundenga from 20-21 February 2012 using questionnaires with open-ended and closed-ended questions. The survey included face-to-face interviews of 80 farmers. Forty farmers were selected in each district of which 20 came from one village. Selection of respondents was based on farmer's willingness to participate in the research. During the data collection process, participants were explained the objective of the study as well as its confidentiality. Interviews were done at farmers' homesteads. Respondents were household heads and in their absence, any member of the household was interviewed. In each district, a lead farmer was identified, contacted and met to make arrangements to meet other farmers and interpreters were used where necessary.

***Analytical procedures***

The data were analysed using the Statistical Package for Social Sciences (SPSS) version 16 (SPSS 16.0 for Windows, Release 16.0.0.2007. Chicago: SPSS Inc).

## Results and discussion

### *Perceptions about climate change*

Most (87.5%) of the respondents in Lichinga and in Sussundenga (90%)were aware of climate variability and change (Table 1). Farmers reported to have noticed significant changes in rainfall and temperature over the past 10 years. There was higher likelihood of insights on climate change with increasing age of the head of the household, which is associated with experience in which farmers observe changes over time and compare such changes with current climatic conditions. Maddison (2006) reported farmer perceptions of climate change through noticing an increase in temperature and a decrease in precipitation. Mubaya *et al.* (2008) also reported that most farmers across southern Africa perceive warming and drying of climate and low unpredicTable rainfall as indicators of climate change. Studies by McSweeney *et al.* (2012), Queface and Tadross (2009) and INGC (2009) indicated that in Mozambique, the mean annual temperature have increased by 0.6° C and the mean annual rainfall decreased at an average rate of 2.5 mm per month between 1960 and 2006.

**Table 1:** Farmers' awareness of climate change over the past 10 years

| | Rainfall | | Temp | Unusual weather conditions experienced | | Noted changes | |
|---|---|---|---|---|---|---|---|
| District | Changed (%) | Un-changed (%) | Changed (hot) (%) | Drought (%) | Heavy rains (%) | Longer rain periods (%) | Shorter rain periods (%) |
| Lichinga | 87.5 | 12.5 | 100 | 0 | 40 | 42.5 | 57.5 |
| Sussundenga | 90 | 10 | 100 | 45 | 0 | 0 | 100 |

N=40

Many (40%) of respondents in Lichinga have noticed heavy rains, while 45% of respondents in Sussundenga have noticed drought in the past 10 years. Most (57.5%) of the respondents in Lichinga and 100% in Sussundenga believe that there is a shift in the beginning of the short and long rains. Rains that would normally start in October and stretch up to April are now starting late in November and in most cases ending in February (Table 2). These results are supported by Usman and Reason (2004) who reported that in different parts of southern Africa, a significant increase in the number of heavy rainfall events have been observed. MICOA (2007) and INGCC (2009) also noted that farmers in the central Mozambique (Sussundenga) are the most likely to experience increased risk of droughts. A study by Ribeiro and Chaúque (2010) revealed that farmers in Mozambique faced prolonged droughts over the last few years causing a decrease in agricultural productivity.

**Table 2:** Changes in planting dates in the last 10 years in percentage

| | Farm operations dates changed (%) | | Planting date for maize 10 years ago (%) | | | | Planting date for maize now (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| District | Yes | No | Sept | Oct | Nov | Dec | Sept | Oct | Nov | Dec |
| Lichinga | 90 | 10 | 0 | 22.5 | 47.5 | 30 | 0 | 7.5 | 22.5 | 70 |
| Sussundenga | 75 | 25 | 5 | 30 | 40 | 25 | 2.5 | 12.5 | 62.5 | 22.5 |

N=40

The findings of this study showed that in the past 10 years 40% of smallholder farmers used to plant in November and but presently over 63% of farmers plant in November. This increase may be explained by the shift in the start of the rains from October to November. These results are in agreement with

those of Mary and Majule (2009), and Mortimore and Adams (2001) who found that the onset of rainfall has shifted from October to November.

***Adaptation to climate change***

Coping strategies to climate change employed by most households include change of crop variety, kitchen gardening and seeking for off-farm jobs (Table 3). Due to increased frequency of droughts, changing crops varieties was a strategy in which 15% of respondents in Lichinga and 35% in Sussundenga were growing drought tolerant crops. These results are similar to those of Mutsvangwa (2009) who indicated that planting drought tolerant crops was the most common adaptive strategy in Gweru and Lupane Districts in Zimbabwe. Similarly, 47.5 of the respondents in Lichinga and 65% in Sussundenga were planting cassava and sweetpotato as an adaptation strategy. However, 90 of the respondents in Lichinga and 82.5% in Sussndenga were reported not to be using drought-tolerant maize varieties. This result are similar to those of Cavane (2011) who reported that improved maize varieties, whose traits have been selected for drought-tolerance were not yet widely adopted. International Fertiliser Development Center (IFDC) (2012) reported that in Mozambique only 5% of smallholders use improved seed varieties. The results confirms those reported in Zambia by Mubaya *et al.* (2008) that farmers do crop diversification to cope with low rainfall.

**Table 3:** Mitigation strategies to climate change effects

| District | Mitigation strategies (%) | | | Mitigations crops (%) | | |
|---|---|---|---|---|---|---|
| | Change crop varieties | Kitchen garden | Off-farm jobs | Cassava & sweetpotato | Cabbage, Onion Tomatoes | Adopting improved maize varieties |
| Lichinga | 15 | 75 | 10 | 47.5 | 2.5 | 10 |
| Sussundenga | 35 | 32.5 | 32.5 | 65 | 5 | 17.5 |

N=40

Results in Table 3 also indicate that Most (75%) of the respondents in Lichinga and 32.5% in Sussundenga are engaged in kitchen gardening. This could be because the farmers take advantage of the wetlands remain charged for a long time after the rains and they therefore grow crops throughout the year. This finding are consistent with those by (Mubaya *et al*, 2008; Oxfam, 2011) which indicate kitchen gardening is a strategy adopted in Zambia and Mozambique to cope with climate change. The results further indicate that farmers in Lichinga (10%) and Sussundenga (32.5%) concentrated more on off-farm activities in times of low rains than in times of high rains. Oxfam (2011) and Maddison (2007) indicated that due to low rains, farmers have moved towards non-farming activities. The workers mentioned that off-farm activities were considered to contribute significantly to the income of rural households.

The results also indicated that 47.5% farmers in Lichinga and 65% in Sussundenga cultivate cassava and sweetpotato as mitigation crop to cope with the effects of climate change. It is also shown that use of horticultural crops such as cabbages, onions and tomatoes is now common. Studies by Maddison (2007) suggested that changes in temperatures and precipitation call for changes in crop varieties more-adapted to mitigate the effects of climate. Studies conducted in Ghana by Acquah (2011) showed that farmers were using different crop varieties as methods to cope with climate change. Respondents in Lichinga (10%) and Sussundenga (17.5%) reported not using improved varieties tolerant to drought because of high costs of seeds. Enete and Achike (2008) and Cavane (2011) indicated that undercapitalised farmers fail to adopt the required level of agricultural technologies that will ensure profiTable return.

**Conclusion and recommendation**

There is a consensus among sampled farmers that under climate change, sustainable agriculture development and livelihoods in Mozambique is one of the greatest problems. This study established that rainfall has been decreasing and the temperature increasing, thus negatively affecting the production and management of crops. Different forms of changes on rainfall have been identified including shrinking of rain seasons due to late onset of rains, shifting from October to November or even December.

A combination of strategies to adapt, such as proper timing of agricultural operations, crop diversification, use of different crop and diversifying from farm to non-farm activities were applied.

Consequently the following recommendations have been proposed on the basis of the study:

- Farmers should be encouraged and enabled to use crop diversification as adaptation coping strategy to guard against crop failure in times of adverse climatic conditions
- All effective adaptation options that farmers have applied in the study area should be widely disseminated to others farmers
- Authorities should formulate sound policies that can strengthen capacity of smallholder farmer to adapt to climate change
- More research should be done in assessing the capabilities of the farmers through in-depth assessment of how they are currently adapting to current climate change impacts. This would help also inform how best they can deal with future challenges of climate change

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