

Mozambique Agricultural Sector Risk Assessment

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This Note examines agricultural risk in Mozambique and its impacts on crop production between 1992 and 2015. It summarizes the findings of an agricultural risk and solutions assessment carried out in 2013 and 2014 to prioritize risks based on their frequency and severity of impact, and to identify any areas of Mozambique's existing agricultural risk management framework that can be improved. These findings led to a number of practical recommendations that can usefully inform strategic planning and policy formulation relating to risk in the country.

RISKS IN MOZAMBIQUE

Production risks

The main sources of production risk observed are drought, flood, cyclone, and pests and diseases. The absence of consistent, time-series data on disaggregated production output posed a challenge, and thus correlation between production risk and production declines could not be performed. The bulk of the analysis relied on qualitative data gleaned from multiple sources. Up to 25 percent of the total population is considered at risk from floods, droughts, and cyclones and may experience production losses due to these frequently occurring events.

Drought was observed to be the most important agricultural risk, considered probable (one event in five years) with catastrophic consequences. An agricultural drought occurs when soil moisture is significantly deficient, resulting in reduced crop yields and output. This can be due to low overall annual rainfall or variations in the timing and

duration of seasonal rainfall, i.e., late onset of rain, early cessation of rain, long rain-free periods, etc.

Flooding is the second-most important risk in Mozambique, with a high probability (one event in three years) of occurrence and critical consequences. Incidence of this risk generally occurs between December and February during the wet season and is often the result of heavy rainfall in a short period of time. This heavy rainfall not only causes flash flooding, but also causes rivers to burst their banks, dykes to be breached, and dams to fail. There is often little time to prepare and effects tend to be localized, compared to the often wide-reaching nature of drought. The years 2000 and 2013 witnessed catastrophic floods leading to severe losses, and on January 8, 2015 heavy rains hit central and northern Mozambique following cyclone Bansi after which a red alert was declared for central and northern Mozambique on January 12, 2015. The WFP estimated around 145,000 people were affected with estimated losses ranging from around \$US 13 million to a high of \$US 28 million, while FAO calculated that

around 2 percent of national planting area was lost which was expected to negatively impact local food supplies. Real GDP growth slowed from 7.4 percent in 2014 to 6.8 percent in 2015 due to low government spending and floods from January to March (Economist Intelligence Unit).

Cyclones are frequent along the Mozambican coastline during the wet season, but are usually not considered particularly destructive if they are below Category 4. In terms of agriculture, most damage is borne by tree crops (cashew, coconut, and fruit trees).

Pests and disease came out as significant, but they do not lead to extreme losses. Insects (red and elegant locusts, lizards, wheat worm, large grain borer, stinkbugs, army worms, bedbugs, and fruit flies), pests (wild animals including boars, monkeys, elephants, and birds) and diseases (cassava fungus, peanut leaf curl, root rot, nematodes (tobacco, tomatoes, beans, fruit flies), brown streak disease, avian flu, Newcastle disease, Trypanosoma, powdery mildew, and tomato virus) have been seen to cause significant risks in Mozambique. While detailed information is lacking, pest damage was analyzed as highly probable (one event in three years) and caused significant damage, but losses were considered controllable with access to the right inputs. Interventions already exist in the form of government, private sector, and NGO programs undertaking aerial spraying for locusts and grain-eating birds, as well as insecticide, pesticide, fungicide, and setting traps for fruit flies, etc.

Market risks

Specifically, market risks including price volatility (domestic as well as international), exchange rate volatility, input volatility, and counterparty risk are observed, but are less significant than production risks. In many instances, crop failure due to production risks triggers price spikes in local markets.

Abrupt and steep price spikes and falls, often driven by underlying production deficits, market factors, or other exogenous factors, are a cause of serious concern with severe implications for



Photo credit: Peter Casler

consumers and producers alike. While the northern region is more self-sufficient in food, local events and regional conditions (in Malawi, Tanzania, etc.), contribute to price volatility. The southern regions are more likely to experience food deficits and often rely on food imports from South Africa. These regions are more exposed to international price volatility, passed down to the domestic markets, as well as local production failures. Commodity price analysis demonstrated relatively fewer episodes of sudden spikes and a general trend of increasing prices, especially over the past 5 years. The price spike of white maize in 2006 was driven by local events (largely drought in 2005), while the 2008–09 jump was a pass-through effect of the global food price crisis. Due to heavy reliance on imports for rice, there is a resulting direct transmission of international price volatility to domestic markets. Among export commodities, cotton is exposed to severe price volatility, while tobacco and cashew are not. The team undertook commodity risk profiles that can be found in the full report.

Enabling environment risks

Enabling environment risk covers many different aspects of legal, institutional, fiscal, and policy volatility and/or uncertainty that impact stakeholders' ability to undertake business within a sector. Conflict and insecurity, political instability, and regulatory risk can all have an adverse impact on the agricultural sector. In Mozambique, the enabling environment is relatively weak, but stable, and therefore is not a significant risk.

IMPACT OF AGRICULTURAL RISKS

Economic losses since 2000 from recurrent water and weather hazards are estimated to have cost Mozambique 1.1 percent of GDP annually (World Bank Global Facility for Disaster Reduction and Recovery). Mozambique ranks third among African countries most vulnerable to climate change (Macaringue 2010:4), and expectations are that it will lead to additional hazards through increased intensity, frequency and greater magnitude of events with sea-level rise and temperature increases of up to 3°C (INGC 2009). As well as crop and livestock losses, agriculture will have to cope with changing rainfall patterns, spatial shifts of pest and disease outbreaks, shorter growing seasons, temperature-induced stress, and shifts in climatic suitability of growing areas (Jarvis et al 2011).

Decreases in growth rates linked to risks/shocks to the agricultural sector have been observed. Figure 1 shows the annual percentage growth in agriculture value added and the impacts of major shocks to the sector: Periods of intense civil war (1985–86 and 1990–1992), drought (1994) and floods (2000) led to negative growth rates. Since 2000 while the growth rate has not dipped into the negative, the occurrence of agricultural risk has had an adverse impact on agricultural growth. The frequent occurrence of agricultural risks also

creates observed food affordability and availability issues for vulnerable rural populations and urban consumers, and has resulted in sudden spikes in the food insecure population (figure 2).

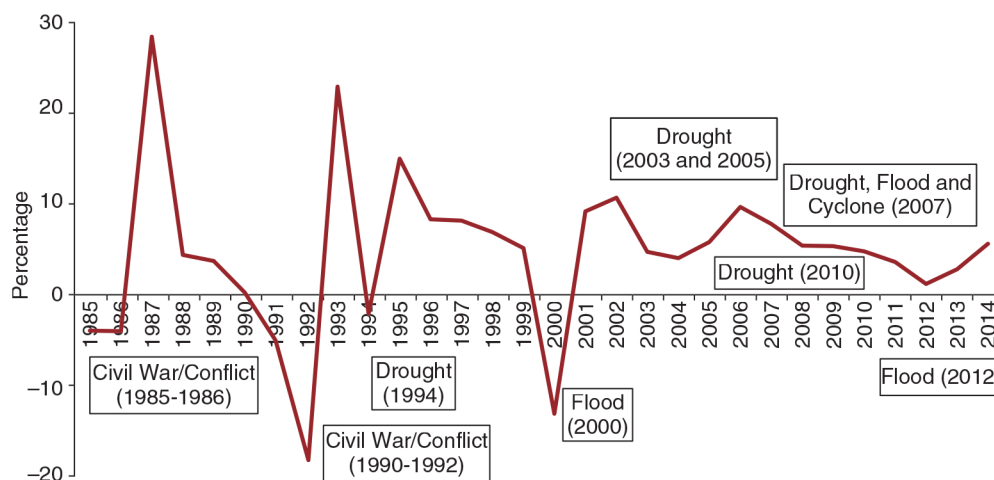
Loss Quantification

Available data on actual losses due to adverse events in Mozambique are not particularly accurate or consistent within individual data sources. In an attempt to facilitate comparison and ranking of the costs and losses due to various events, different data sources were combined to generate a more or less consistent time series. Figure 3 uses data from 1996 to the first quarter of 2015 to quantify the frequency and severity of the impact of major production risks. Drought and flood emerge as the two highest-cost agricultural risks in Mozambique, followed by pest and disease outbreaks. While drought happens less often, they result in far more losses than experienced due to floods which happen more frequently.

POTENTIAL RISK INTERVENTIONS

To address the priority risks, the assessment team deployed a holistic agricultural risk management framework, comprised of mitigation (action taken to reduce the likelihood of events, exposure, and/or potential losses), transfer (transfer of risk to a

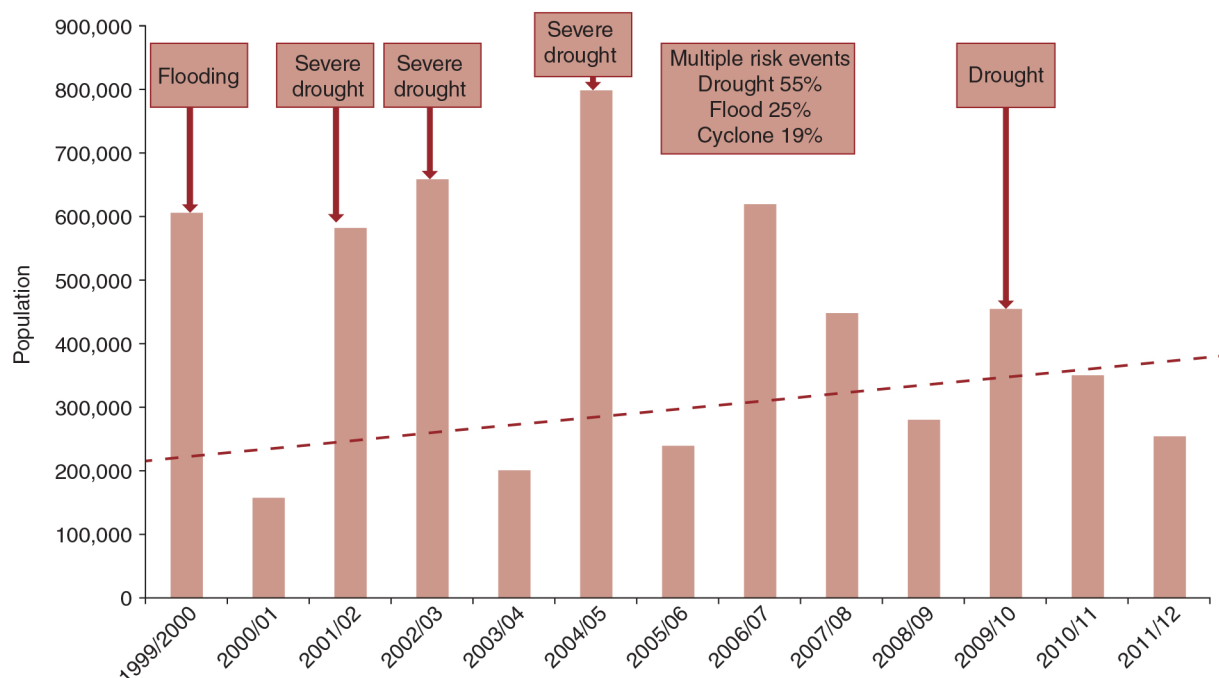
FIGURE 1: Major shocks to production: Annual percentage growth in agriculture value added



Source: World Development Indicators.

Note: A drop would be expected after the large 2015 flood. The figures that would reflect the effect of the 2015 flood are not currently available.

FIGURE 2: Acute food insecure population in Mozambique



Source: Technical Secretariat for Food Security and Nutrition.

willing party, at a fee or premium), and coping solutions (activities geared toward helping cope with losses) to identify a list of potential interventions. Risk transfer solutions (insurance and hedging), owing to Mozambique’s specific context, have limited applicability and will be quite challenging to implement. Coping solutions (social safety net programs) are required and quite important; however, they do not address fundamental risk issues in the agricultural sector and have limited applicability as a long-term solution. As ex-post actions, coping solutions are generally expensive and do not transfer or mitigate the risk or help with making the overall sector and those within the sector more resilient in the long run.

Risk mitigation is perhaps the most needed type of intervention, and the most overlooked, with the highest returns in addressing short- and long-term risk issues in Mozambique’s agricultural sector. It is important to highlight that most of these potential interventions are complementary in nature, and are required to effectively address agricultural risks. Considering the resource limitations, decision filters (see table 1) were used to help evaluate and

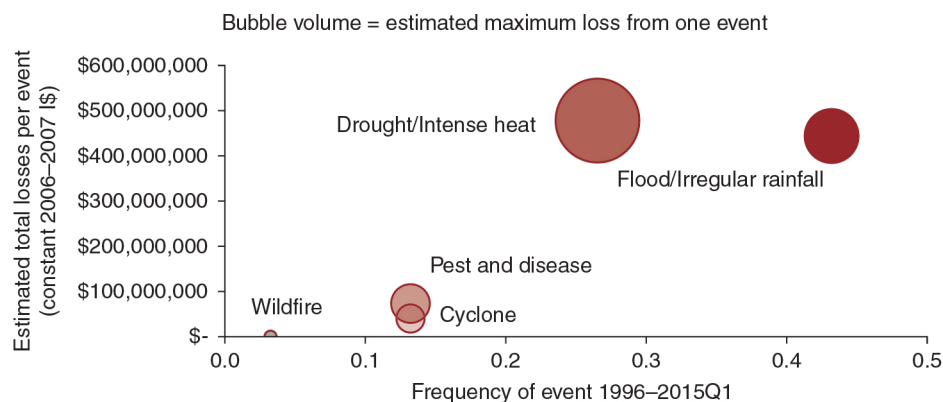
prioritize interventions with the greatest potential to generate sizable risk management benefits. These were completed by the team, but also by stakeholder participants in the consultative workshops.

Based on the prioritization of risk and intervention measures, three intervention categories were identified that would potentially lead to the greatest risk management benefit. They align with the Strategic Plan for Agricultural Development (PEDSA) and the National Agriculture Investment Plan (PNISA) and while many of them are being implemented already and are having positive impacts, albeit at a localized level, a greater emphasis should be placed on scaling-up these interventions on a broader, national level to make a meaningful impact on the agricultural sector in Mozambique as a whole.

WATER MANAGEMENT

The potential interventions for the water management component would target both floods and droughts; the scope of this assessment is focused on small-scale interventions, such

FIGURE 3: Estimated aggregate total losses by risk event



Source: Authors' calculations.

as irrigation and drainage schemes, and water conservation measures, such as multi-functional boreholes, water harvesting, and improving cropping practices to conserve soil water. In the short term, potential interventions include: a soil conservation inventory of wetlands and small dams, development for water management, assessment and re-design of major dykes for floods, and small dams for droughts. Potential medium- to long-term interventions include: a Limpopo river basin Integrated Flood Management study, Light Detection and Ranging surveys in Limpopo and Zambezi, low-cost, small-scale irrigation, and development of small- and medium-scale irrigation, as well as continuation in improvement and expansion of the hydrometrical network for flood warning at the district level.

Specific actions that were recommended during the stakeholder workshop include:

Small-scale irrigation

- Pump dry-season irrigation from lower river areas and groundwater in dry savannah areas.
- Supplementary irrigation (with water harvesting) in higher plateau areas (with annual rainfalls of 1,000–1,600mm) for rain-fed crops, and where rivers are suitable, small earth dams would be considered as reliable water sources.
- Small diversion weirs and gravity water supplies on perennial streams in upstream catchment areas on the margins of areas 1 and 2 above where steeper

slopes exist. For more reliable streams small earth dams for larger areas of irrigation could be considered.

- 30,000 hectares would be funded by the Government of Mozambique but 20,000 hectares of privately funded irrigation would be facilitated by the National Institute of Irrigation with linked outgrower schemes where feasible (most likely for sugar and horticulture).

Small/medium earth dams

- 30 small/medium dams/weirs 5–10m high on smaller catchments and/or groundwater development for livestock and domestic use.

Dyke development

- Targeting of existing dykes including those rehabilitated in the Limpopo Valley that need re-design.
- Proposal of new dykes on currently unprotected schemes.

Water storage — boreholes

- New construction of 100 boreholes for the 33 districts where annual rainfall is below 500mm with short rainy seasons and livestock raising.

CONSERVATION AGRICULTURE

There are 3.9 million small-scale farmers in Mozambique of which 60,000 to 120,000 may have been exposed to conservation agriculture techniques and adopted some aspect of them on at least a

TABLE 1: Filtering of Risk Management Interventions and Potential for Multiple “Wins”

<i>Intervention*</i>	Reduces the risk	Reduces the losses	Compensates after the loss	Improves the yield	Climate change mitigation	Climate change adaptation
<i>Soil and water conservation measures (conservation agriculture)</i>	Y	Y	N	Y	Y	Y
<i>Improved access to extension services</i>	Y	Y	N	Y	Y	Y
<i>Improved water management practices</i>	Y	Y	N	Y	N	Y
<i>Altered crop patterns</i>	Y	Y	N	N	Y	Y
<i>Flood control infrastructure investment</i>	Y	Y	N	Y	N	Y
<i>Small-scale irrigation</i>	Y	Y	N	Y	N	Y
<i>Improved market information system</i>	Y	Y	N	N	N	N
<i>Timely and reliable availability of weather information to farmers and other stakeholders</i>	N	Y	N	Y	N	Y

*Other interventions filtered but not listed here include: large-scale irrigation, building tolerant varieties system, regional coordination, promotion of integrated pest management, subsidized crop insurance, commercial catastrophic weather insurance, sovereign risk financing, saving/credit, on-farm storage, social safety net programs, and facilitating temporary migration.

Note: Y = Yes, N = No

part of their land. Traditional on-farm practices are not adequately addressing the challenges brought about by risks and are therefore contributing to ongoing poverty and food insecurity. No single solution can be fully effective without the accompanying support of other measures that fall into the categories of marketing and enabling environment. Conservation agriculture can contribute to effectively improving resilience to climate change if the extension system conveys reliable, site-specific messages that acknowledge farmers’ constraints and if implementing agencies work to be coherent, focused, capable, and efficient.

Drought resilience

- Minimum soil disturbance to reduce energy requirements, retain moisture, maintain microorganisms, inhibit germination of weeds, and avoid creation of pans in the soil profile which constrain root penetration.
- Retention of crop residue as mulch or cover crops to maintain moisture, stabilize soil temperature, sup-

port microorganisms and activity to resist erosion.

- Crop rotation with legumes to break the pathogen multiplication cycle, increase nitrogen content and open channels for soil aeration.
- Agro-forestry with leguminous *Faidherbia albida* trees that drop their leaves in the rainy season, recycling deep-sourced nutrients and allowing crops to be grown without being shaded out.

Flood tolerance

- Drainage of fields with ditches.
- Raising ridges from potential waterlogging of the root zone.
- Contour bunds and planting of vetiver grass along contours to prevent erosion.
- Minimum tillage to reduce energy demand and avoid creation of pans in the soil profile which constrains root penetration.

Improved economic resilience

- Yield improvements through the use of inputs.

- Diversification towards crops that are better suited to the changing climate.
- Timing (including early planting) and spacing precision to make plants more resilient to later dry spells and to substantiate the root system for improved access to nutrients and tolerance of drought and resilience to lodging in wet and windy conditions.
- Design and implementation of mechanization programs.

ACCESS TO EXTENSION AND INFORMATION SERVICES

The current ready access of farmers to timely, accurate, and localized information about impending events can have significant impact on crops and is required for preemptive actions by farmers to reduce exposure or losses. There are extensive challenges faced in dealing with access to extension services and information in the current context. Extension officers are often the only public agricultural officer at a community level and are extremely difficult to attract to the most rural areas. Despite much work going on, a number of gaps are emerging or still exist. What is missing is the coordination and interaction between the different sources of information and knowledge, as well as interaction with other stakeholders. This would be a first step toward innovation. Another gap is the fact that extension and information systems do exist, but only a few farmers are reached, while the information channels accessible to farmers, such as community radios, are not adequately used.

Three categories of interventions emerged from the discussion in the stakeholder workshop and work of the team:

Coordination for innovation

Coordination of the knowledge and information services in agricultural risk management both horizontally (between multiple innovation system actors and service providers) and vertically (between local, provincial, and national levels), as well as within services (for example, between crops and natural resource research) is required:

- Knowledge Management Portal on Climate Change.

Knowledge management through different ministries and other actors. Regular meetings and agreed actions on knowledge management. Strengthening the executive secretariat and actively supporting facilitation of meetings and action plan development.

- Provincial Climate Change Platforms. Contribute to provincial and district planning on Climate Change mitigation and adaptation issues through guidelines and capacity development.
- PIAIT, Conservation Agriculture and other technical Working Groups. Continuation of the Conservation Agriculture (and irrigation) inventory including local practices for agro-ecological zones and around Zonal Research Centers. This platform is important to enhance the development of resilience strategies, which are based on farmers' knowledge, which can be corridor or zonal specific.

Extension Services

Capacity development of subject matter and frontline extension workers is needed. Capacity development within organizations for information management to enhance innovation in addressing drought and flood risks is also required. Specific actions include:

- Environmental focal points in agriculture will be trained in order to guide planning at the province and district levels.
- Training of trainers to train extensionists (theory and practice) on small-scale irrigation and conservation agriculture, as well as other risk mitigation measures. This includes extension approaches such as Farmer Field Schools, Farmer-to-Farmer training and demonstration plots.
- Training by extensionists of local leaders (religious and traditional, etc.), who have an influence on local bylaws in relation to risk management (e.g. wind-breaks and wildfire control).
- Organization of committees on specific agricultural risk management areas at the national and corridor/provincial level (stocktaking and coordination, conservation agriculture, and irrigation).

Information services

Coordination and integration of different information services, such as using market informa-

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CONCLUSION

Questions remain about how to operationalize and work toward increasing the resilience of the sector. The World Bank is already involved through Climate Change and Agriculture Development Policy Operations in areas that cover some of the interventions recommended during the Agricultural Sector Risk Assessment (ASRA) and the Agricultural Sector Risk Solutions Assessment (ASRSA). The assessments have provided evidence-based and systematic prioritization followed by policy dialogue and government co-ownership. Short-term risk management solutions are provided with the anticipation that they point toward longer-term adoption of practices and interventions with an emphasis on resilience.

tion services as a carrier for more agricultural risk related information and mitigation measures. The suggested actions are:

- Training of extension staff on how to use information services, such as broadcast media (radio, television), and the press (local newspapers, etc.), but also on announcing field days, etc.
- Improvement of the quality of Community Radio programs and in particular the improvement of interaction with clients and feedback services, based on existing experiences.
- Development of a virtual platform for different info services for eventual joint services (SMS), which also contributes to better coordination in the information chain.

Effective risk management requires a combination of coordinated measures, some of which are designed to remove underlying constraints and others to address a risk or subset of risks. Integrated risk management strategies are often considered to be more effective than one-off or stand-alone programs. Having taken a systematic approach, the team anticipates that future work informed by the ASRA and ASRSA will add value to major stakeholders interested in improving the resilience of the agricultural sector in Mozambique, particularly in the three identified areas.

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