

Economic Losses and Poverty Effects of Droughts and Floods in Malawi

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Droughts and floods are a capricious part of life for many Malawians. The country depends heavily on rain-fed agriculture and so it is crucial that we understand the implications of these climate events. Not only are rural livelihoods affected, but urban households are also vulnerable to food shortages and rising prices. Finding ways to overcome the losses from droughts and floods is a policy imperative.

A recent study by the International Food Policy Research Institute (IFPRI) estimates the economic losses from extreme climate events in Malawi. The study simulated agricultural production losses during climate events in an economywide model to assess their impacts on other parts of the economy and on household incomes and poverty in different administrative regions.

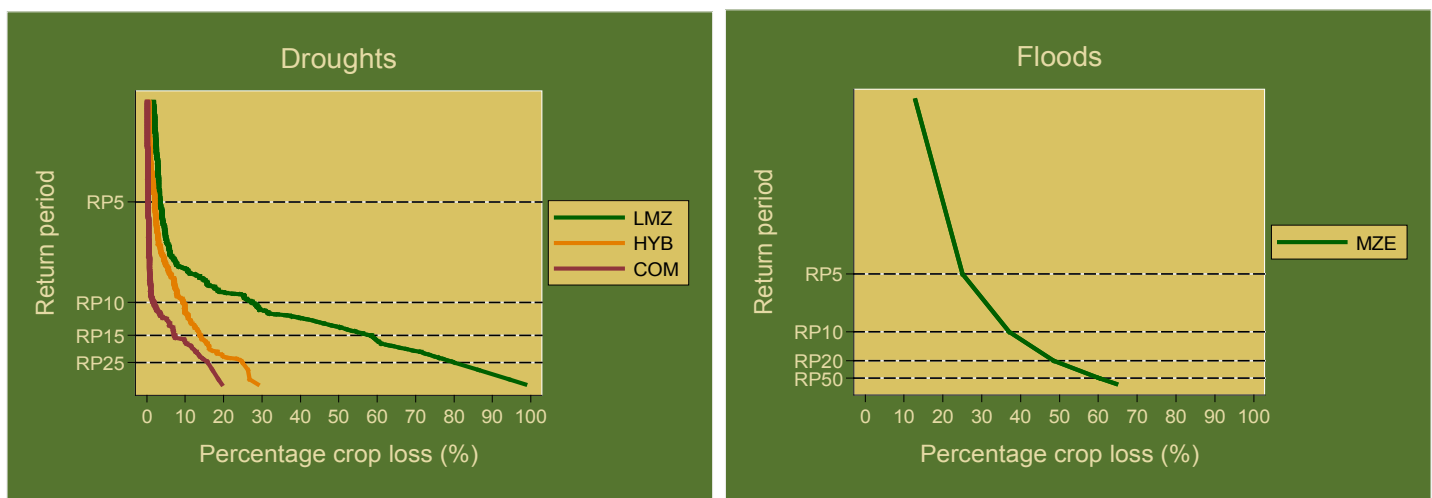
Estimating crop production losses

The economywide model's simulations draw on the findings from a World Bank study that used meteorological and hydrological models to examine past drought and flood events in Malawi. The study estimated the expected crop production losses occurring during events of different severities. The return period (RP) of a climate event is used to measure its severity and is

formally defined as the expected time that occurs between two events of similar severity. For example, the severe drought that took place in 1991-92 was an "RP25" drought. This means that it is only expected to occur once every 25 years.

Based on historical production and climate patterns, Figure 1 shows the maize production that is lost during climate events of different RPs. The crop loss figure for droughts (left panel) separates maize by its varieties: local (LMZ), composite (COM) and hybrid (HYB). Local varieties are worst affected by droughts. For example, local maize production is expected to fall by at least 27 percent during an RP10 drought, whereas hybrid maize production falls by 10 percent. Composites are found to be most drought-resistant.

Figure 1: Maize and tobacco production losses



Notes: LMZ = local maize; HYV = high yield varieties; COM = composite varieties; MZE = all maize crops combined.

Source: Pauw et al. (2009)

The IFPRI study estimated drought-induced maize production losses for the entire country, as well as non-maize crop losses. The figure for floods (Figure 1, right panel) shows the loss for all maize crops combined (MZE), as physiological differences between maize types are irrelevant during floods. Flooding mainly occurs in the Shire River basin in the south, and hence the losses shown only apply to crop production in the southern region of Malawi.

Uncertainty over when droughts and floods will occur is a serious problem for short-term risk management. However, Figure 1 provides a useful tool for longer-term planning. For example, from the figure it is possible to estimate the average annual loss (AAL) caused by droughts and floods over a long period of time. These calculations show that, on average, Malawi loses 4.6 percent of its maize production each year due to droughts (based on today's adoption of different varieties). Similarly, about 12 percent of maize production is lost each year to flooding in the southern region, where about one-third of Malawi's maize is grown. Droughts and floods are therefore a major obstacle for agriculture and food security in the country.

Measuring the economic costs of droughts and floods

The study imposed estimated crop production losses, like those in Figure 1, on an economywide general equilibrium model of Malawi that captures farm and nonfarm sectors and households in different parts of the country. The model is based on information from a wide range of sources, including national accounts, foreign trade data, and a 2004-05 household survey. By integrating this information, the model estimates macro impacts on agricultural and national gross domestic product (GDP) and micro impacts on employment and household poverty. A brief summary of the results is provided below.

Table 1. Percentage change in GDP during droughts and floods

	<i>Droughts</i>					<i>Floods</i>				
	<i>RP5</i>	<i>RP10</i>	<i>RP15</i>	<i>RP25</i>	<i>AAL</i>	<i>RP5</i>	<i>RP10</i>	<i>RP20</i>	<i>RP50</i>	<i>AAL</i>
GDP	-0.5	-3.5	-7.2	-10.4	-1.0	-1.7	-2.5	-3.2	-4.0	-0.7
Agriculture	-1.1	-7.3	-14.9	-21.5	-2.0	-3.5	-5.1	-6.5	-8.2	-1.4
Industry	0.0	0.0	0.3	0.7	0.0	-0.6	-0.9	-1.2	-1.6	-0.2
Services	-0.2	-1.3	-2.8	-4.4	-0.4	-0.5	-0.7	-0.9	-1.2	-0.2

Note: The table shows real GDP changes measured at factor costs.

Source: CGE model results from Pauw et al. (2009)

On average Malawi loses US\$12.5 million or 1 percent of GDP each year due to droughts.

Model results indicate that a severe drought like the one in 1991-92 reduces national GDP by 10 percent (see Table 1). However, a drought of this severity is only expected to occur only once every 25 years. During more regular but less severe droughts, such as an RP5 event, GDP contracts by 0.5 percent.

Agriculture suffers the greatest losses, with declines in GDP ranging from 1.1 to 21.5 percent during RP5 and RP25 droughts respectively. The ensuing food shortages cause domestic grain prices to rise while grain imports increase rapidly to cover the shortfall. Maize imports, for example, increase by between 6 and 256 percent during RP5 and RP25 droughts respectively.

Droughts also have macroeconomic implications. Tobacco accounts for a third of the country's export earnings. Thus, when demand for maize imports rise and tobacco production and exports fall, it causes Malawi's exchange rate to depreciate.

A shortage of agricultural commodities also hampers production in the nonfarm economy. For example, households engaged in downstream food processing are adversely affected by rising agricultural prices. Similarly, poultry is hurt because maize is an important animal feed. Many services are also closely linked to agriculture, such as trade and transport, and so this sector also contracts during droughts. However, some sectors in the economy are fairly insulated from droughts. For example, model results show that industrial production may actually expand during some droughts as exporting firms take advantage of the depreciated exchange rate and the lower wages demanded by workers displaced from agriculture.

Smallholder farmers and the Machinga and Ngabu regions are the worst affected by droughts: Drought impacts vary widely across Malawi. The southern Machinga and Ngabu (or Shire) regions are the worst affected, losing 3 to 4 percent of agricultural GDP on average each year due to droughts. This is because agriculture is particularly important in these regions and because farmers depend on crop varieties that are more susceptible to droughts. In contrast, the average loss in agricultural GDP in Salima is less than 1 percent. Here about a quarter of agricultural land is allocated to non-tobacco export crops such as irrigated sugarcane, a crop that is not only largely unaffected by droughts, but also benefits from the depreciating currency.

A greater reliance on local maize varieties also explains why small- and medium-scale farmers suffer larger losses than their large-scale counterparts. Average crop losses due to droughts are 2.8 percent for small- and medium-scale farmers, compared to 1.3 percent for large-scale farmers.

On average, poverty is 1.3 percentage points higher due to droughts, affecting 154,000 people: Out of 12.1 million Malawians, 52.4 percent, or 6.3 million people, are considered poor. Droughts cause poverty to increase further, both directly through its impact on household incomes and indirectly through its impact on consumer prices. At the national level, an RP5 drought causes a 0.7 percentage point increase in the poverty rate (see Table 2). This rises to as much as 16.9 percentage points during a severe RP25 drought.

Poverty rates are twice as high in rural than in urban areas. Given the importance of agriculture in the rural economy, it is not surprising that the rural poor are found to be more sensitive to droughts. Small- and medium-scale farming households are particularly vulnerable. However, model results find that, on average, nonfarm households are as vulnerable to droughts as farm households. In other words, the percentage point increase in poverty is similar for farm and nonfarm households. This reflects the important impact that food prices have on nonfarm household welfare.

Improved maize varieties are effective at mitigating some drought losses: If managed correctly, hybrid (HYB) and composite (COM) maize varieties are not only more drought tolerant, but they are also associated with higher crop yields than local varieties (LMZ). Malawian crop data for the last decade shows that HYB yields are about 2.6 times that of LMZ, and COM yields are 1.8 times higher. If as little as 10 percent of land

currently under LMZ is replaced with COM, production gains of 6.5 percent can be realized during a normal (non-drought) year. It would take an RP8 drought year to wipe out these gains, but even then production levels would be 7.8 percent higher than what would have been achieved during an RP8 drought under Malawi's current mix of maize varieties.

Adopting improved maize varieties therefore produce "double dividends" of increased yields during normal years and lower yield losses during drought years. This is an important additional benefit for food security in Malawi. It also suggests that the benefits of providing improved seeds and fertilizer are higher when considered in the context of climate uncertainty. For example, when estimating the returns to Malawi's Agricultural Input Subsidy Program, we need to consider both the yield gains from improved varieties and their greater drought-tolerance.

Floods are localized and so their national-level GDP impacts are less severe than droughts: Compared to droughts, the flood scenarios have similar but smaller macroeconomic effects. Losses in agricultural GDP during floods range from 3.5 to 8.2 percent during RP5 and RP50 floods, respectively (see Table 1). Thus, even during a severe RP50 flood the exchange rate depreciation remains fairly modest. This explains why industrial producers are hurt during floods, but not during droughts (i.e., the gains for exporters no longer offset declines for agro-processors). National GDP declines by between 1.7 and 4.0 percent during RP5 and RP50 floods respectively.

On average Malawi loses US\$9 million or 0.7 percent of GDP each year due to floods in the southern regions of the country: The northern and central regions experience small increases in crop and livestock production levels during flood events. These benefits reflect the increased demand for their outputs in the face of flood-induced shortages in the country. Floods have different impacts on the three southern regions. Crop and livestock production losses in Machinga (6.8 percent) and Ngabu (5.9 percent) are relatively larger than those experienced Blantyre (4 percent). This reflects differences in farmers' crop choices, which affects their exposure to floods. Small- and medium-scale farmers bear the brunt of floods, with recorded average annual production losses of 2.7 and 2.2 percent respectively compared to the small gains realized by large-scale farmers.

Poverty rises sharply in the southern region during floods: Poverty in the south increases by between 5.9 and 15.2 percentage points during RP5 and RP50 floods respectively, with an average annual increase of 2 percentage points (see Table 3). Since two-thirds of the south region's population is already poor, heightened vulnerability to floods is a major social challenge for

Malawi. Flood impacts are smaller than drought impacts at the national level, although the national poverty rate still increases by 2.7 and 6.3 percentage points during RP5 and RP50 floods. On average, the poverty rate is 0.9 percentage points higher each year due to flooding. This pushes an additional 111,000 people below the poverty line, most of whom live in the southern region.

Table 2: Droughts: Changes in poverty rates

	Initial poverty rate (%)	Percentage point change in poverty		
		RP5	RP25	AAL
National	52.4	0.7	16.9	1.3
Urban	25.4	0.5	13.3	1.0
Farm	30.0	0.2	11.4	0.6
Non-farm	21.2	0.7	14.9	1.3
Rural	55.9	0.7	17.4	1.3
Farm	56.7	0.7	17.4	1.3
Small/Med-scale	58.3	0.7	17.8	1.3
Large-scale farm	30.6	0.7	4.8	0.7
Non-farm	37.5	0.6	16.6	2.1

Table 3. Floods: Changes in poverty rates

	Initial poverty rate (%)	Percentage point change in poverty		
		RP5	RP50	AAL
National	52.4	2.7	6.3	0.9
Urban	25.4	0.5	13.3	1.0
Rural	55.9	0.7	17.4	1.3
Farm	56.7	0.7	17.4	1.3
Southern region	66.6	5.9	15.2	2.0
Small/Med-scale	58.3	2.9	6.8	1.0
Non-farm	37.5	3.9	8.4	1.3

Note: Both tables measure poverty at the official poverty line of US\$115 per person per annum (2004-05 prices)

Source: CGE model results from Pauw et al. (2009)

Summary

Taken together, droughts and floods cost the Malawian economy about 1.7 percent of its GDP every year. This is equivalent to almost US\$22 million (measured in 2005 prices). Important lessons emerge. Farmers' crop choices clearly matter. Maize, which is a staple crop in Malawi, is vulnerable to droughts. This is particularly true for local maize varieties. Crop diversification and the adoption of more drought-resistant maize varieties are therefore important mitigation strategies, bearing in mind the production technology adjustments that may be required by such a move. People in the southern region are particularly vulnerable to floods. The high incidence of poverty in this region and the sensitivity to climate shocks attest to adverse impacts that regular droughts and floods events have on people's welfare in the long run. This brief has outlined the potential costs of droughts and floods while also highlighting the uncertainty surrounding these extreme climate events. However, this quantification of the potential losses is merely the first step towards the development of a risk management strategy for Malawi.

This Policy Note has been prepared by Karl Pauw and James Thurlow as an output for the Malawi Strategy Support Program. The brief draws on two reports for the World Bank by Pauw, K., Thurlow, J., and Van Severter, D. 2009. Droughts and Floods in Malawi: Assessing the Economywide Effects and RMSI 2009. Malawi: Economic Vulnerability and Disaster Risk Assessment. The note is intended to promote discussion and has not been peer reviewed. Any opinions stated herein are those of the author(s) and do not necessarily reflect the policies or opinions of IFPRI.

The Malawi Strategy Support Program of the International Food Policy Research Institute (IFPRI) works closely with the government of Malawi and other development partners to provide information relevant for the design and implementation of Malawi's agricultural and rural development strategies.

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