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Extreme Weather and Poverty Risk: Evidence from Multiple Shocks in Mozambique

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Thanks to strong economic growth over the last two decades, poverty in Mozambique has decreased and the average household is now more likely to access basic education, health, and housing. Yet, the country is still ravaged by intense and frequent weather disasters. To determine the scale and nature of the impacts of these shocks, this paper analyzes the vulnerability of rural livelihoods across three different extreme weather events: droughts, floods and cyclones. The study finds that per capita food and non-food consumption and asset ownership are reduced among households affected by any of the three weather shocks. Their children are less likely to attend school, have a higher probability of falling sick and show higher engagement in paid and unpaid work. What's more, staple food prices are disrupted and remain affected nearly a year after the disaster. Helping households confront these events requires comprehensive risk management policies, including making agriculture more resilient to weather, improving the functioning of credit and insurance markets, facilitating economic diversification and market access, and increasing the availability of flexible safety nets – all before the shocks occur.

Mozambique's high levels of exposure and vulnerability to weather shocks threaten economic and social progress. Mozambique has recovered well after the end of its war in 1992. Its GDP expanded by 7.2 percent from 2000 to 2016 and the share of Mozambicans living below the poverty line decreased from 60.3 to 48.4 percent between 2002/03 and 2014/15. But the regular occurrence of severe weather events risks be putting a brake on this progress. Mozambique ranks high among African countries in terms of exposure to natural disasters like cyclones, floods, and droughts. Nearly a quarter of the population lives in areas extremely likely to experience a natural disaster and climate change is only expected to amplify this vulnerability. For instance, tropical storms were four times more likely to impact any given rural area during storm seasons

in 1991-2015 than from 1968-1990. These issues combined make low-income Mozambicans especially vulnerable to more natural disasters in the future. If Mozambique wants to end extreme poverty by 2030 and achieve sustained growth, it must assess and address the comprehensive impacts of these shocks.

Assessing household vulnerability to multiple and varied weather shocks

This work investigates whether households in Mozambique are systematically vulnerable to major weather shocks, irrespective of the type of event. Households can be affected by shocks in

¹ This note summarizes the key findings of a larger working paper: Baez, Javier; Caruso, German and Niu, Chiyu. 2018. "[Extreme Weather and Poverty Risk: Evidence from Multiple Shocks in Mozambique](#)". Policy Research Working Paper; No. 8667. World Bank, Washington, DC. © World Bank.

many ways: they can lose their assets, increase how much work they do, eat less food, cut back on other basic consumption and decide to put their children to work. They may also self-insure ex-ante, opting for lower risk, lower return economic activities. Most studies of this kind measure the impact of a single event on some of these outcomes. However, by concurrently analyzing the effects of three independent weather shocks across time and location, the empirical analysis can document whether household welfare is more sensitive to some weather risks than others.

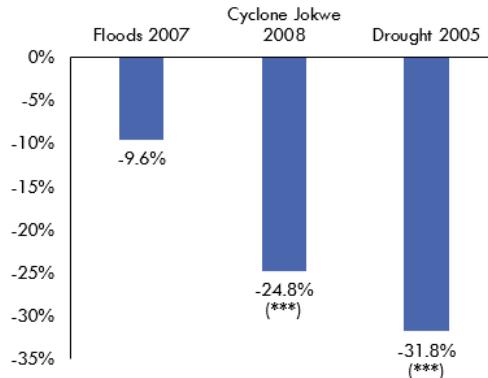
The study investigates the impacts of three large weather shocks. (1) the floods that occurred between late 2006 and early 2007 along the Zambezi River Basin, (2) a category 3 cyclone (called Jokwe) that struck northeastern Mozambique between March 8 and 18, 2008, and (3) a drought that affected parts of central and southern Mozambique between May 2005 to January 2006. The empirical analysis is produced using multiple household surveys, weather data from ground stations and satellite data and spatial data on main crop growing cycles. The study also performed multiple robustness tests to issues such as migration, alternative survey samples or different definitions of affected areas. The analysis also examined the effects of fourth, more recent event: the floods that affected Zambezia, Nampula and Niassa provinces in central and northern Mozambique in early 2015.

Many aspects of household welfare are vulnerable to extreme weather, regardless of the type of event

The findings show that households are highly vulnerable to all the shocks analyzed across multiple measures of welfare. Food security is

systematically undermined among affected households across the disasters. People cut back on the most basic of needs; for instance, people consumed 25-30 percent less food due to the shocks, as seen in Figure 1. Back-of-the-envelope calculations without accounting for possible substitution effects suggest that affected individuals reduced their average intake by nearly 150-200 calories per day. This is important in a context where 43 percent of children under five show serious signs of height stunting for their age. Households also consumed less of everything else. Cyclone Jokwe, for example, reduced household consumption by over half (54.8 percent), and the drought reduced consumption by nearly a quarter (21 percent) relative to those unaffected. The impact even pushed some of the households below the poverty line; both the drought and the cyclone increased the poverty headcount by 12 and 17.5 percentage points respectively.

Figure 1. Food consumption per capita fell significantly among households in affected areas



Note: Parameter estimates of triple-difference models expressed as the effect on the dependent variable of a change of one standard deviation in the shock intensity measure. Asterisks denote statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Weather shocks defined in standardized z-scores of totals in the year of the event using the historical distribution from the reference period 2000-2012 for each district.

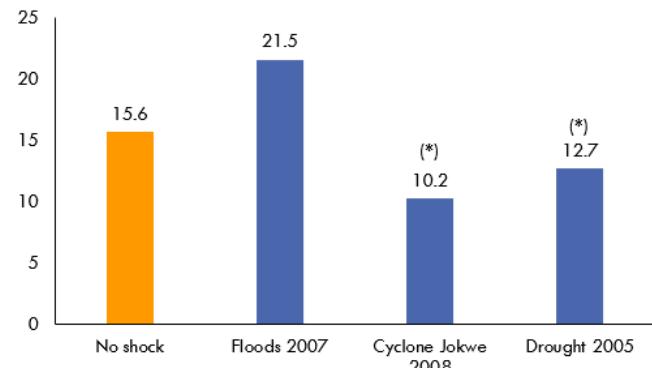
Source: Baez, J., G. Caruso and C. Niu (2018)

Shocks also deeply impacted children's welfare, across multiple measures. Overall, children from affected households were 8.3 percentage points less

likely to attend school relative to unaffected children. They also became less healthy: child morbidity rates increased by fourfold in flooded districts. Intriguingly, child morbidity fell by nearly half in districts after the 2005 drought, so further study is needed to figure out what happened to cause the decline. A typical coping response of shock-affected households is to increase how much adults and children work. The evidence for Mozambique also confirms this behavior. 18 to 65-year-olds are 33 percentage points more likely to be either working or actively looking for work, and children (ages 5 to 17) also increase their labor activities. The rise in child labor attributed to the floods is very dramatic: a fourfold increase relative to the level observed at baseline.

Asset holdings, including productive assets, were found to decline among affected households. The study also found that households hit by cyclone Jokwe lost one-third of their belongings, and those affected by the drought lost nearly one-fifth (Figure 2). Given the localized nature of the shocks, it is possible that their assets were sold at lower prices than normal, since disasters pressure many households in affected areas to sell assets at roughly the same time. The loss of assets hurts their ability to generate income and grow out of poverty in the long run. Affected households also obtained transfers from other households at higher rates to cope with the disasters' effects, an indication of the presence of informal risk-sharing arrangements across households. For instance, after Cyclone Jokwe, affected households were almost twice as likely to receive transfers compared to levels recorded from unaffected communities.

Figure 2. Asset ownership fell among affected households



Note: Change in wealth index of households in affected areas relative to unaffected households. Parameter estimates of triple-difference models expressed as the effect on the dependent variable of a change of one standard deviation in the shock intensity measure. Robust standard errors clustered at the district level. Asterisks denote statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Weather shocks defined in standardized z-scores of totals in the year of the event using the historical distribution from the reference period 2000-2012 for each district.

Source: Baez, J., G. Caruso and C. Niu (2018)

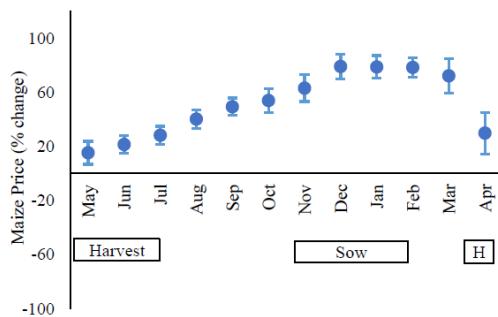
The Disruption of Food Markets

The shocks translate into increased food price variability. Agriculture in Mozambique is largely traditional, practiced mostly by smallholder farmers that rely on rainfall for water and have low input utilization and technology adoption. The farmers mainly consume what they grow, are isolated from others, and the agricultural markets are not well integrated. Hence, extreme weather is expected to disrupt crop yields, triggering supply- and demand-side effects in food markets. To analyze the effects of the shocks on the prices of staples, the study tracked maize prices for three reasons: it is the staple most widely produced and marketed, its yields are highly determined by the timing and quantity of rain, and it constitutes a significant part of the Mozambican diet. Overall, the analysis finds that maize prices close to affected locations were deeply affected by weather shocks (Figure 3). However, weather shock impacts prices differently. For example, during the 2005-2006 drought, prices rose by 78.9 percent and remained

29.3 percent higher one year after the drought. However, the floods in 2007 followed the opposite pattern; we found maize prices in affected locations decreased by over 40 percent for the first three months.

Figure 4. Maize prices in markets close to affected areas are sensitive to the occurrence of weather shocks

(Effects of drought - 2005)



Note: Graphs show point estimates of the effect on prices for an increase of a standard deviation in the disaster intensity. Bars show 10% confidence intervals. Impact estimates calculated for each month in a 12-month period following the weather shock. Weather shocks defined in standardized z-scores of totals in the year of the event using the historical distribution from the reference period 2000-2012 for each district.

Source: Baez, J., G. Caruso and C. Niu (2018)

What Can be Done About It?

Comprehensive disaster risk management policies need to be in place to increase the resilience of vulnerable households and keep natural shocks from turning into natural disasters. First, countries must provide basic public goods before shocks occur. This is done by investing in goods and services like education, health, water and sanitation, and connectivity. Households with more human capital and access to better economic opportunities can better weather the effects of shocks. Second, countries must make sure essential markets, like agriculture, insurance, credit, and labor

remain functional to bolster communities already deeply affected by the shocks. Third, countries must make human and physical capital more "resilient". For instance, they should strengthen country-wide immunization, standardize building codes, build flood defenses, and incentivize household insurance. Fourth, countries must invest in learning more about the impacts of risks. This is done by increasing the ability of organizations to collect statistical and satellite data, integrating weather forecasting and early warning systems, and supporting more applied research in this field. Finally, scalable safety net policies are necessary to ensure that individuals can experience minimally acceptable standards of living after shocks occur.

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